ELECTRONICS Australia

HIFI NEWS

DECEMBER, 1975
AUST 80c* NZ 80c

Photo by arrangement with TRIDENT TELEVISION PTY LTD

IS YOUR TV COLOUR ALL WRONG?

Your pictures may be too blue, too green, too red — or sepia

READ WHAT OUR OBSERVATIONS REVEALED

DYNAMIC FILTER IMPROVES SOUND MOVIES

MOISTURE CHECKER FOR PLANTS * DICE GAME

Registered for posting as a periodical — Category B

How to get two Hi-Fi units for the price of one...

Sony's new Stereo Receivers (STR7025, 7035, 7055) (Component-quality Amplifier and FM-AM Tuner with 1.7 μV high sensitivity, 60dB selectivity)

Now that FM high fidelity stereo broadcasting is finally here, most hi-fi fans are adding a quality FM tuner to their rigs.

But newcomers to high fidelity (and those who are upgrading) are in luck . . . with Sony's new STR Series FM-AM Receivers, they can get *both* a component-quality tuner and a powerful amplifier for no extra cost.

Take the Sony STR7025, for instance. For under $350 you get a highly sensitive and selective FM-AM tuner, beautifully integrated with a 24 watt per channel stereo amplifier.

For anyone starting or improving a stereo system, the STR7025 is a great place to begin.

With Sony-engineered quality throughout, it will make even a cheap turntable or speakers sound better.

You get

- All the input and output controls you'd expect from Sony, including MIC mixing and four speaker outlets.
- Direct coupling for tighter, cleaner bass.
- Reserve power: 24 watts per channel (4 ohms) continuous RMS at 1 kHz.
- Low noise. Low distortion. S/N Phono 60 dB I.M.D. less than 0.8% at rated output.
- Frequency response: 30-40 kHz.

The tuner section's specifications are equally impressive:

- High sensitivity: 1.7 μV.
- Minimum interference is assured by FETs in the front end.
- Selectivity is 60 dB with solid state filters to reject adjacent channels.
- Extra wide tuning dial.
- Capture ratio as low as 1.5 dB.

The STR Series reflects Sony's usual crisp, appearance design, integrated here into an impressive whole. The two functions are of course wholly independent: your enjoyment is only limited by your own interest in experimenting with sound—beautiful sound by Sony.

Check out the STR Receiver Series at your Hi-Fi retailer soon. Sony STR7025, STR7035 and STR7055. One of them is the ideal source for your future stereo system.

SONY®

Research makes the difference

GAC.S.7552

ELECTRONICS Australia

Australia's largest-selling electronics & hi-fi magazine

VOLUME 37 No 9

Developed in our laboratory, this multi-purpose circuit can be used as a voice-operated relay to control a tape recorder, or as a VOX circuit for a transmitter. It can be used with both low impedance and high impedance microphones, or with a high level source such as a tuner. Details on page 38.

Continuing our series on improving poor movie sound tracks, our third and final article details the dynamic noise filter pictured above. Full constructional article commences on page 32.

On the cover

Our cover photograph forms the basis for this month's Forum topic. It shows a range of otherwise identical Decca 63cm colour TV receivers, specially set up to show how colour balance can be completely upset by maladjustment. This month, Forum looks at the problem of colour balance in colour TV receivers and discusses our own observations to date. (Photo by arrangement with Trident Television Pty Ltd.)

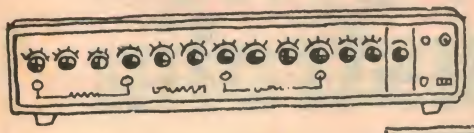
CONTENTS—DECEMBER, 1975

world of electronics and hi-fi

projects and technical

regular features

SAVE ON OUR STOCK CLEARANCE

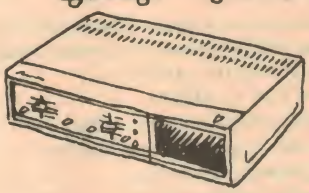


1. 100 Watt Clubsound P.A. System consisting 100 W Amp with 4 inputs separate bass and treble control on each channel—built in reverberation—plus 2 sound columns each containing 3 wide range 12 inch speakers.

***$575.00**

2. 120 W P.A. Amplifier 2 input separate bass and treble controls on each channel overload protected Type LBH 1010.

***$230.00**

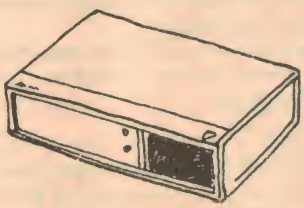


3. 60 W Power amplifier ideal for extending a system Type LBH 1007 (same cabinet as LBH 1010).

***$126.50**

4. 60 W P.A. Amplifier 2 inputs separate bass and treble controls on each channel overload protected Type LBH 1008.

***$184.00**

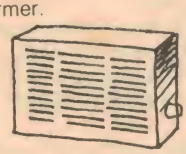


5. EV 4572 Sound column speaker containing 4 wide range 8 inch speakers power 20 Watts.

***$103.50**

6. VN 1110/00S Wall mounting speaker enclosure containing 8 inch twin coned speaker and tapped transformer.

$29.00



7. HR 3 Super Tweeter 35 Watts, Frequency 2 kHz to 17.5 kHz.

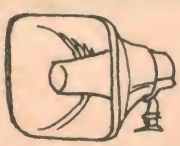
$50.00

8. APC 30T Wide Angle 30 Watt Reflex Horn with Driver and tapped transformer.

***$92.00**

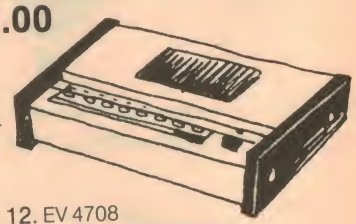
9. AP 30T 30 Watt Reflex Horn complete with driver and tapped transformer—screw driver adjustment.

***$62.00**



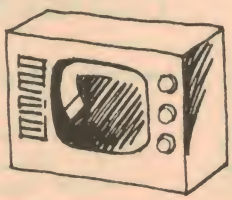
10. WR10T 10 Watt Horn suitable for music complete with tapped transformers.

$44.00



11. EV 4707 10 Channel intercommunication master station with all-call facility.

$115.00

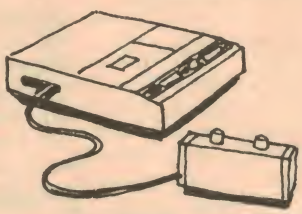


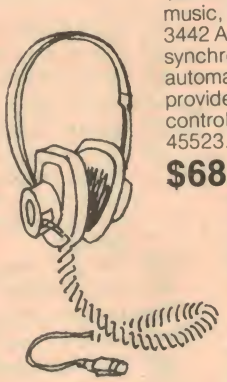
12. EV 4708 Remote Station for above.

$13.50

13. PYE LDM 0826/07—22 inch PAL colour monitors video and audio input (No R. F. front end). Cabinet may need touch up. Price does not include insurance or freight. Both payable to carrier.

$500.00





14. N2209 Cassette recorder suitable for music, dictation etc, supplied with LFD 3442 Adaptor which provides capability to synchronise cassette sound to most automatic slide projectors (those which are provided with a connection for remote control in accordance with DIN Standard 45523.

$68.85 complete

15. LCH 0007/01 Stereo dynamic headphones 30 Hz to 20 kHz 600 OHM (300 OHM Parallel) feather-light shock resistant, intended for high quality monitoring of speech or music. Mono to stereo change effected by altering contact connections in 6 Pin plug.

$19.00

*For these items add $5.00 Freight each
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PHILIPS

Editorial Viewpoint

Reflections on the Novice controversy

If you thought I was being rather nasty in my October editorial by suggesting that the Wireless Institute might have been responsible for having the 2-year limit placed on the Novice amateur licence, I commend to you one of the letters we publish this month on page 90. Written by Mr Rex Black, who was founder of the Youth Radio Club Scheme and Chairman of the WIA's own investigating committee into the Novice licence, it certainly supports my suggestion.

Traditionally a prime function of amateur radio organisations like the WIA has been to negotiate with licensing authorities on behalf of their members, with a commitment to gaining as much as possible in terms of rights and privileges. It now seems clear that in their negotiations for the Novice licence the WIA broke with this tradition, by deliberately asking that the licence NOT be given permanent status. This was apparently done against the specific advice of its own investigating committee, and in a situation where the authorities would most likely have given the licence permanent status had they not been asked otherwise.

Regardless of the motivation behind this step, it seems to me that a very dubious precedent has been set. Perhaps the time is ripe for the many sensible and sincere people in the WIA to do some serious thinking, and decide just where their organisation should be heading.

On a more general note, the quite arbitrary nature of the decisions which have been made concerning the Novice licence seems to me to provide further evidence of the pressing need to re-think the whole question of administering use of the electromagnetic spectrum in Australia.

At the moment, quite apart from voluntary and commercial organisations, we have no less than four separate official bodies involved in this administration: the PMG's Department, the Department of the Media, the Broadcasting Control Board, and the ABC. Each controls or influences certain chunks of the spectrum, and tends to use different criteria in making and implementing decisions. As a result the administration of this important public resource tends to be incoherent, erratic and far too heavily dependent upon bureaucratic caprice and political manoeuvring.

Surely it is about time we gave serious thought to centralising the administration of the total spectrum in a single statutory body, perhaps modelled on the US Federal Communications Commission. While there are dangers in any centralised authority, there is also the opportunity to rationalise, integrate and ensure that planning decisions reflect the best interests of society as a whole.

If you agree with this, I suggest you write to your local MP. It's probably the only way things are likely to be changed.

In the meantime, on behalf of all of us here at E-A I would like to wish all readers and advertisers a merry Christmas, and a happy and prosperous new year.

—Jamieson Rowe

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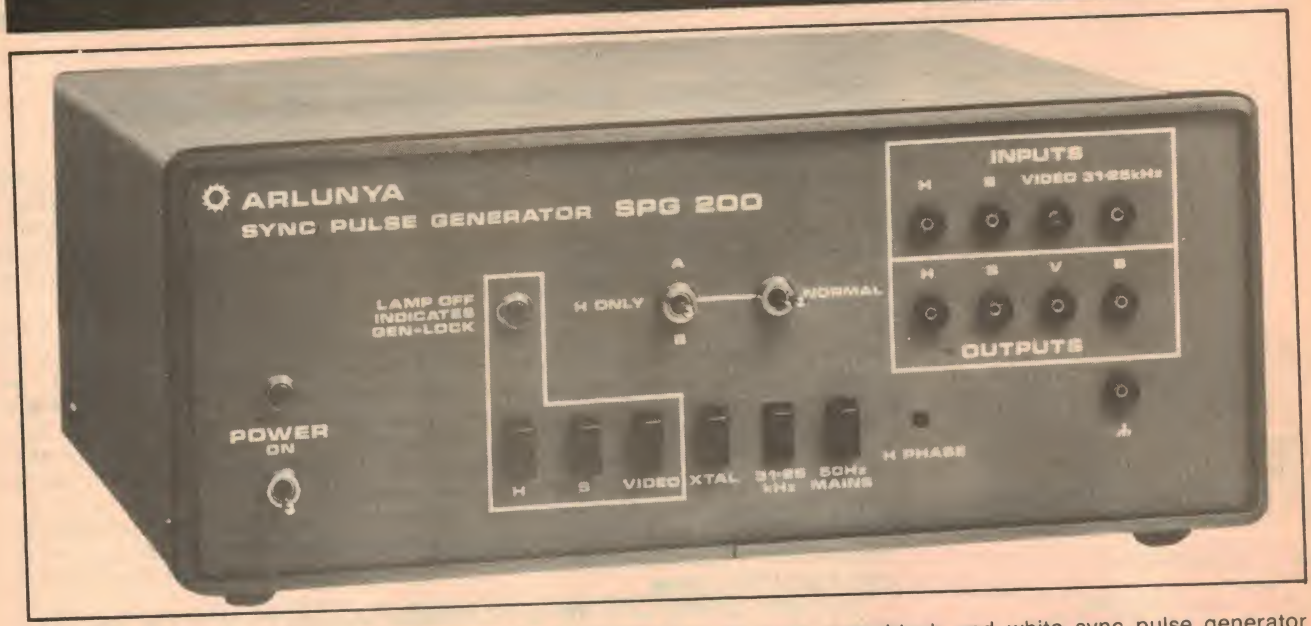

SYNC PULSE GENERATOR SPG200 The SPG200 is an all solid state black and white sync pulse generator (compatible with CCIR system B) for use in TV studios and closed circuit TV installations. Maximum use of integrated circuits ensure optimum reliability even under adverse (0-50°C) environmental conditions.
Rear panel outputs: composite sync, composite blanking, horizontal and vertical drives.
Operating modes: internal crystal lock, synchronisation from an external 31.25kHz source, gen-lock to external composite video, composite sync or horizontal drive signals and mains-lock. In gen-lock modes phase of the line synchronising pulse may be varied by +3.OuS relative to incoming line synchronising reference pulse by a screwdriver adjustment on the front panel. A front panel lamp gives positive identification of correct gen-lock operation. Signal monitoring points for all incoming and outgoing pulses are provided on the front panel.
An important feature of the SPG200 is the facility to gen-lock on to non-standard composite video signals particularly those generated by helical scan video tape recorders. In Gen-lock (video) mode four degrees of noise immunity to the incoming video signal are selectable by means of two toggle switches on the front panel. Three of these sub-modes have been designed to make the SPG200 suitable for use with both single and double head helical scan machines by means of internally generated inhibit pulses which cause the phase-locked loop to ignore sync information during predetermined drop-out intervals.

VIDEO PROCESSING AMPLIFIER VPA202 For Colour CCTV Systems the VPA202 is used with the SPG200 to form a complete self sufficient colour sync pulse generator with gen-lock facilities. In this configuration the standard composite sync; composite blanking, horizontal and vertical drives produced by the SPG200 are supplemented by a 4.433619 MHz sub carrier output, burst flag and pal ident. outputs to provide colour capability. The SPG200 plus VPA202 combination will also provide a processing and stabilising system for both monochrome and colour signal sources.
Both the SPG200 and VPA 202 come in the same size bench mounting cases or if desired can be supplied as one composite 19" rack mounting assembly.
The combined system will provide all of the functions normally found in a professional process amplifier including controls for system level (remote and local) chroma level, white limit level (remote and local), set up (remote and local), sync level, burst amplitude phase and position.

LINE SELECTOR LS16 This modest cost instrument is used in conjunction with a general purpose oscilloscope to select and display particular lines in a composite video waveform.
In the frame mode the trigger pulse derived from the composite video signal is coincident with the line number as selected by a multiple thumbwheel digital switch on the front panel.
In addition a line mode is provided in which a half line frequency trigger pulse is positioned by means of the front panel multiple thumbwheel switch mentioned above. In this mode the digits indicated on this switch give the time interval from the end of the line blanking.
A third, auxiliary, mode enables the instrument to be used as a pulse frequency divider whose ratio (up to 999) is set by the same multiple thumbwheel switch.

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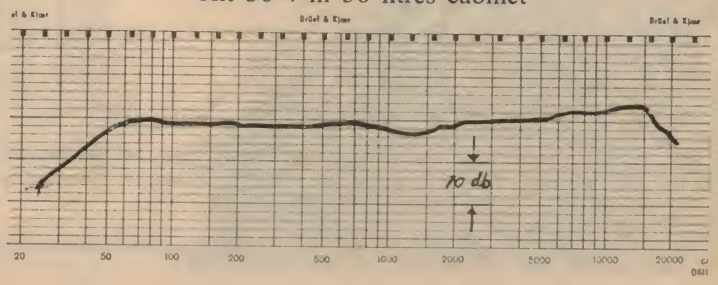

Further information from . . . Victoria — Danish Hi Fi. Western Australia — Danish Hi Fi.

Queensland — Brisbane Agencies. N.S.W. — Convoy.

Shure, Kenwood show off new lines

The Conference Centre of Sydney's Boulevard Hotel was the scene, recently, for two enterprising audio/hifi presentations. The first was by Audio Engineers Pty Ltd representing Shure products; the second by Jacoby Mitchell Ltd to familiarise dealers with the expanded range of Kenwood hifi products.

by NEVILLE WILLIAMS

Although Shure Brothers are perhaps best known in the consumer hifi field for their range of magnetic cartridges, the main thrust of the most recent seminar was in the area of professional audio equipment, typically for public address, recording, radio and television.

Jim Kogen, Shure's Vice President in charge of engineering, explained how his company had gradually moved from the primary role of microphone manufacturers towards meeting a much wider need. The microphones, mixers and the rest of the P.A. equipment in use at the Seminar appeared to carry the Shure brand and, from what Jim Kogen had to say, Shure and its distributors are moving quite positively into large scale public address in the USA.

Jim Kogen also made the point that, leaving aside the inexpensive units found in portable tape recorders and Citizens Band equipment, Shure Brothers are the world's leading manufacturers of quality microphones. From subsequent snippets of conversation, I gathered that Shure not only manufactured for their own brand name, but they also produced a share of the units sold by other traditional suppliers. Their share of the professional market in Australia would seem to be about 50%.

The actual demonstration of Shure microphones was done by Ken Reichel, Chief Sales Engineer, who seems to combine the advantages of an unfaltering presentation with the ability to manipulate tangles of equipment without putting a wrong foot forward. At least that is the impression he has created in two lectures in Sydney within the last twelve months.

Amidst the assortment of more familiar microphones, three new lines caught the attention of the audience, even if they may not all be available immediately.

The first was the PE5EQ, which may or may not be marketed in Australia under that exact type number. The "EQ" indicates "equaliser" and refers to the fact that the microphone has switchable equalisation built right into the stem, accessible to the system operator per medium of a ball-point pen, or something else slim enough to actuate any of four tiny switches.

In introducing the microphone Ken Reichel explained that acoustic feedback tends to show up first in the frequency band where the total system gain is greatest. Even if the microphone, amplifier and loudspeaker system is ideally flat, the acoustic environment may put a lump in the electro/acoustic loop gain and promote premature feedback anywhere in the audio passband: bass, middle or treble.

Another familiar problem which professional operators face is the need to match the system response to a particular need. Performers who tend to produce unduly "chesty" sound or excessive sibilants may sound better, respectively, with reduced bass or treble response. Again, if a hard sax or trumpet tone is appropriate, the system can operate flat, but the producers may prefer to "sweeten" the sound by reducing the middle register.

The desired result can, of course, be obtained by means of an adjustable filter unit in the amplifier chain but there is a limit to the number of such units which can be provided or accommodated in a complex multi-microphone set-up. Accordingly, operators have traditionally had to provide themselves with an assortment of microphones from which they can select the most appropriate for any given situation. It tends to be a costly and not always efficient approach.

Shure's new PE5EQ microphone solves all these problems at one stroke. In the stem are four switches which can introduce a 10dB drop in gain in bands centred on about 130, 800, 2000 and 5000Hz. Ken Reichel demonstrated the efficacy of the approach, on the spot, by creating a feedback-fringe condition in the P.A. system and switching in the appropriate filter.

He also played recordings indicating the effectiveness of the filters in dealing with "chesty" sound and sibilants, and in "sweetening" orchestral music, where such was the objective.

An interesting aspect of the design is that the introduction of all four filters restores the microphone to its normal wide frequency response, the only difference being that the curve is lowered bodily by about 10dB. The effect is that of introducing a 10dB loss pad in the line—a handy feature where there is any danger of preamp overload.

SHURE SR-10 AUDIO CONSOLE

Shure's new SR101 portable audio console can mix the output from eight separate microphones, with individual control over volume, reverberation and equalisation. The console contains a long list of input/output/operator facilities, is fully solid-state with protective circuitry, and has underwriters' certification overseas. It can be rack mounted or used as a portable unit, with optional panel lighting and carrying case accessories. Details from Audio Engineers Pty Ltd, 342-344 Kent St, Sydney 2000.

TUNER AMPLIFIERS EXPLAINED

KR-1400**
FM Tuner Section—Sensitivity Usable IHF: 2.6 uv. Frequency Response: 20 Hz-15,000 Hz + 0.5 db-2.0 db. Signal to Noise: 60 db at 1 M/V input. **AM Tuner Section**—Sensitivity Usable IHF: 30 uv. Signal to Noise: 40 db at 1 M/V input. **Main Amplifier**—Power Output: 10 + 10 watts RMS into 8 ohm load at 1,000 Hz. Both channels driven. Total Harmonic Distortion: 1% at rated power into 8 ohms. Power Bandwidth: 25 Hz to 30,000 Hz.
$259.00*

KR-2400**
FM Tuner Section—Sensitivity Usable IHF: 2.5 uv. Frequency Response: 20 Hz-15,000 Hz. Signal to Noise: 62 db at 1 M/V input. **AM Tuner Section**—Sensitivity Usable IHF: 25 uv. Signal to Noise: 45 db at 1 M/V input. **Main Amplifier**—Power Output: 16 + 16 watts RMS in 8 ohm load and 1,000 Hz. Both channels driven. Total Harmonic Distortion: 1% at rated power into 8 ohms. Power Bandwidth: 10 Hz to 30,000 Hz.
$319.00*

KR-5400**
FM Tuner Section—Sensitivity Usable IHF: 1.9 uv. Frequency Response: 20 Hz to 25,000 Hz + 0.5 db-1.5 db. Signal to Noise: 68 db at M/V input. **AM Tuner Section**—Sensitivity Usable IHF: 18 uv. Signal to Noise: 45 db at 1 M/V input. **Main Amplifier**—Power Output: 35 + 35 watts RMS into 8 ohms 20 Hz-20,000 Hz. Both channels driven. Total Harmonic Distortion: 0.5% at rated power into 8 ohms. Power Bandwidth: 10 Hz to 30,000 Hz.
$540.00*

*Recommended Retail Price.
**Averaged manufacturers' specifications subject to change without notice.

A tuner is a further programme source as is a turntable or cassette deck. Tuners enable you to receive radio broadcasts and may be a separate unit or as is often the case, combined with the amplifier. They are then called Receivers or Tuner Amplifiers. The tuner/amplifiers above are examples of good amplifier/tuners. They aren't cheap, but nor is any good hi-fi component. Their specifications are their credentials. If you understand them, you'll know just how good they are. If you're a bit lost with the specifications, we have just the thing: "The New, Improved, Updated, More Detailed Hi-Fi Explained in Simple Language by Kenwood Booklet". It will make these specifications much clearer. Because when you know more about good hi-fi, you'll be better able to appreciate Kenwood hi-fi.

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We want you to know what good hi-fi is all about, so we are giving you our booklet absolutely free. It is a complete dictionary of hi-fi terms and explanations, available at your nearest hi-fi specialist, displaying the Kenwood sign.

JM 254

KENWOOD CASSETTE, DISC PLAYERS

Another quite dramatic demonstration involved a new close talking anti-noise microphone intended for use by commentators broadcasting from extremely noisy locations.

Ken Reichel pointed out that noise cancelling microphones are commonplace, but to date, most have been bulky, using twin diaphragms and characterised by a narrow, rather lumpy response. Used for broadcasting purposes, their metallic sound contrasts badly with normal wide-range speech microphones.

The new PE52 microphone uses a single diaphragm approach, as pioneered by Shure some years ago, and exhibits a much smoother and wider response, allowing it to be integrated without obvious discrepancies, with studio quality units. The microphone must be used within about 3cm from the speaker's lips, since the level drops dramatically for more distant sounds.

Using the P.A. system and a tape recorder, Ken Reichel filled the conference room with rock orchestral sound so loud that it completely masked any attempt to talk above it. He then proceeded to do an on-the-spot commentary into another recorder using the anti-noise microphone, and a standard uni-directional type, close-up, for comparison. When played back later, speech via the uni-directional mic was intelligible but no more than that; via the anti-noise mic, the unwanted din was just faintly audible in the background.

In typical crowd situations, the new anti-noise mic rejects so much of the background that a second "crowd" microphone is desirable to ensure convincing atmosphere. Far from negating the purpose of the exercise, use of a second microphone allows the producer to mix for exactly the desired effect, and also allows the commentator to switch his own microphone off for coughs, asides, etc, without interrupting the flow of crowd sound.

Also intended for use by commentators is a new microphone headset type SM10. Again, as Ken Reichel pointed out, headset microphones are not new but the traditional types have tended to be bulky and heavy, or so obvious on the head and in the area of vision, that they produce user resistance.

The new Shure SM10 has a very light adjustable frame, which rests over the head, clear of the ears and clear of possible spectacle frames. A tiny dynamic microphone, no larger than the top of a finger, and attached to a gimbel mounted stem, swings from the headband down near the corner of the wearer's mouth. There it is scarcely visible, is protected from breath blasts, yet is very close to the wearer's lips.

A similar demonstration with this unit, made against a deafening background of crowd noise, pointed up the ability of the SM10 to favour the commentator's voice, while delivering a pleasant non-peaky sound.

An elaboration of the SM10, type SM12, has a tiny earphone attached to the frame. It normally rests near—not in—the ear canal and can be used to feed either sidetone to the commentator, or voice cues, or both. In fact, Ken Reichel indicated that it should be entirely possible to supply a microphone headset with two earphones, if such ever proved to be necessary.

A practical accessory to the headset is a small control head which can typically be clipped to the commentator's belt. It serves to terminate the very light multicore cable attached to the headset and also provides a button to silence the microphone as necessary.

The Kenwood presentation was hosted by David Kinsman, manager of Clemenger/Aston Advertising and Mike

"New for '76" is this front-loading KX-620 cassette player/recorder by Kenwood. The traverse mechanism has all normal functions plus built-in autostop. Circuit switching is provided for "reserve" equalisation in addition to "normal" and "CR02", while input can be taken from line, mic/DIN, or mic/DIN with in-built attenuation. Specifications and price are consistent with what one expects for a high quality domestic deck.

The Kenwood KD-2033 record playing deck has a notably slim look and offers to the user good electrical and mechanical performance, without too many frills and at a competitive price. This and other Kenwood products will be stocked by hifi dealers but further information is available from Jacoby Mitchell Ltd, 215 North Rocks Rd, North Rocks, NSW 2151.

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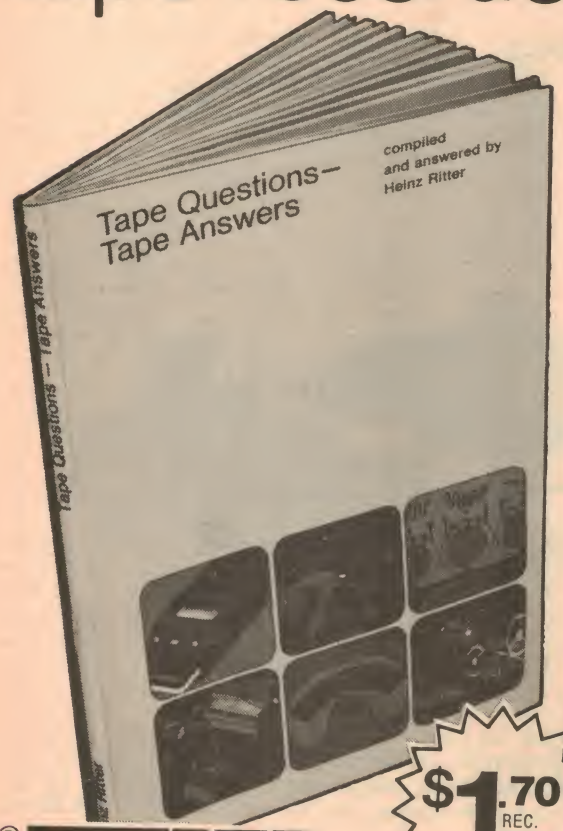

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Hall, National Sales Manager of Jacoby Mitchell Ltd.

Mike Hall said that the Kenwood philosophy for 1976 would be to focus attention on the extensive range of Kenwood hifi components: players, amplifiers, receivers, cassette decks, loudspeakers etc. While they could obviously be assembled into complete high quality systems, each of the components was versatile and attractive in its own right.

With that aspect in view, Kenwood advertising would concentrate on the nature and features of the various hifi components, presented against a background of informative technical copy. The advertising would be aimed initially at deliberate rather than casual readers, using technical and information media headed up by "Electronics Australia".

Intended primarily for use in multi-channel loudspeaker systems, this potentiometer assembly is intended to control the level from tweeter units, while presenting a substantially constant impedance to the divider network. Catalogued as item AT-40, the control is being distributed by the components division of Plessey Australia Pty Ltd.

Turning to the actual products line, Mike Hall emphasised that most of the components established during the current year would be carried over into '76, but that a number of new items would be introduced progressively.

Included amongst the new lines would be the KX-260 front-loading cassette recorder/player, as pictured. Basic idea of the configuration is to obviate the need for getting at the top of the unti, so that it can be housed in a relatively limited shelf space, or stacked.

Technical specifications of the KX-260 are in line with other high quality domestic cassette decks and the recommended retail price of $299 is likewise competitive.

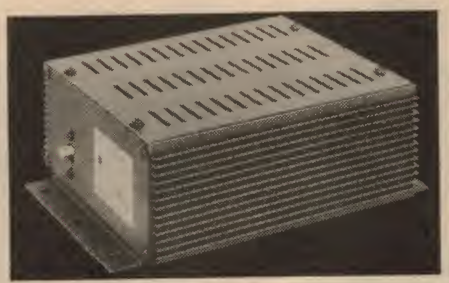
Also of interest are two new record players, notable for their slim styling.

The KD-2033 is a semi-automatic player, fitted with a 4-pole synchronous motor and using belt drive. It provides anti-skating bias, automatic return and cutout, and has a wow and flutter rating of less than .06% RMS. It is normally fitted with a moving magnet cartridge with a rated frequency response from 20 to 20,000Hz. Recommended retail price is $169.00.

From the specifications, this new Kenwood KD-3033 player would appear to be basically similar to the KD-2033, but it includes facilities for fully automatic operation, powered by an entirely separate motor. At retail level it costs an extra $50.00.

For those requiring a player offering somewhat greater facilities, the Kenwood KD-3033 offers full automatic operation, with an entirely separate second motor to power the automatic functions. Belt drive ensures a wow and flutter performance better than .06% RMS, while a moving magnet cartridge offers a frequency response from 20-20,00Hz. The recommended retail price is $219.

For those interested in a still more exotic player, Kenwood has a new direct drive model, which was on display at the seminar, but not yet ready for Australian release.



For those who are looking for more than the usual level of sound in their car, Pioneer have come up with an add-on power amplifier type AD-304. According to the literature, it can be used in conjunction with any car radio or stereo unit, and can be tucked away in any suitable corner in the vehicle. Taking its output from the present radio or stereo player, it can provide up to 15W RMS per channel into 4-ohm speakers. (For further information: Pioneer Electronics Aust Pty Ltd, 178-184 Boundary Rd, Braeside, Vic.)

CASSETTE DECKS: Plessey Australia have recently concluded an agreement with Tanashin-Denki by which that company's cassette decks will be marketed in Australia, principally to manufacturers of radiograms and home music systems. Tanashin-Denki may be a relatively new name to many but, in fact, the company claims that they are currently supplying about 30% of the world market for cassette deck mechanisms. In terms of numbers, this adds up to about 4.5 million decks per year.

The Garrard Division of Plessey Australia, at Villawood NSW, will have exclusive distribution rights for the mechanisms for Australia and New Zealand, and they will therefore take a logical place alongside the established line of Garrard disc record players. The range includes a variety of cassette mechanisms, together with 8-track cartridge players.

PLESSEY LOUDSPEAKERS: Following the successful release of two loudspeaker systems PE800 and PE1000 (see our October issue, p. 11) Plessey Australia have announced the third system in the new range, type PE1200. Using a woofer with roll surround and a supplementary complement of tweeters and mid-range loudspeakers, fed via a cross-over network, the PE1200 has a power rating of 30W RMS. The cabinets are of hand finished wood construction, faced with an acoustically transparent foam grille. manufacturers as National, Pioneer, Victor, NEC, and Marubeni.

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The comparison with conventional tape: An amazing gain in maximum output of 4.5dB at 400Hz and 7dB at 12.5kHz!

Ideal for use with all Sony tape and cassette players with "Fe-Cr" positions, this new tape will still give remarkably improved response through any high quality tape player which has "SLH," "Special" or "Low-Noise" tape positions.

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Rotel RA-812 stereo amplifier

A long-established Japanese manufacturer, Roland Electronics Co Ltd, now has a new range of Rotel amplifiers on the Australian market. Here we review the Rotel RA-812, which is rated at 45 watts per channel.

A fairly large styling format is used to display the large range of controls and facilities on the front panel. No less than eighteen knobs, switches and jack sockets are arrayed on the panel and in addition there are two meters which directly indicate the power output into assumed 8-ohm loads.

Dimensions of the RA-812 are 430 x 140 x 330mm including knobs, rubber feet and rear terminals. Mass is 11kg. An oiled timber case is supplied with the unit.

Rotary controls are provided for Source Selector, Loudspeaker Selector and Tape Monitor Switch. The Source Selector provides for connection of two turntables using magnetic cartridges as well as high level sources such as FM tuner. The Loudspeaker Selector allows connection of either or both of two loudspeaker systems, as well as switching both off to allow headphone operation only. In addition, the Loudspeaker Selector has a mode marked "4CH" which gives a simulated 4-channel operation using resistive mixing.

For panel decoration, the two meters are provided. These give only an approximate indication of the power developed with a steady tone and are quite useless in indicating peaks or possible overloads. Strictly panel decoration only! A row of LEDs would be far more useful for indicating the power on peaks and intermittent overloads. To our knowledge, at least one amplifier already incorporates this feature (the Bose 1801).

We liked the large knob for the Volume control—there is less likelihood of turning the wrong control. However, the concentric balance control is too close to the control panel and as a result fingernail scratches are left on the panel every time it is used. These scratches rub off easily but they are still undesirable. We prefer to see a separate Balance Control.

Seven toggle switches are used to provide Subsonic, Low and High filters, Tone defeat, Stereo-mono mode, Loudness and Muting. The Subsonic filter operates at 12dB/octave below 15Hz while the Low filter operates at 12dB/octave below 70Hz. The subsonic filter needs to have a higher cut-off, at say 30Hz, and/or a steeper rate of attenuation to be of much use in preventing low-frequency wobbles from discs from reaching the loudspeakers.

For once we can favourably comment on the Low and High filters because they at least have an adequate rate of attenuation at 12dB/octave. Other manufacturers please note!

The tone defeat switch does just that—switches out the tone controls so that the amplifier response reverts to a flat condition. This is a convenience feature only, as a slightly more extended response can be achieved by merely setting both tone controls to their centre settings.

The muting switch is a handy feature as it enables a fixed reduction (15dB) in the Volume setting without touching the Volume control. Handy for temporary interruptions such as answering telephones.

All of the lower half of the rear panel is taken up by the large finned extrusion which acts as a heatsink for the four output transistors. The rest of the panel is occupied by an impressive array of input and output sockets and two-pin mains outlets.

Adjacent to the phono inputs are two switches which provide a choice of input sensitivity—2mV, 4mV or 8mV—and also a choice of input impedance of 30k, 50k or 100k. While these may appear to be good features they are really superfluous. The only reason for having adjustable senstivity for the preamplifier is to provide the optimum overload margin for a particular cartridge. However, even in the maximum sensitivity condition, the preamplifier has more than adequate overload margin at 200mV.

Similarly, the impedance switch is of dubious utility. Most cartridges are designed to drive a 50k load. When fed into a 100k load they sound brighter or harsher and when fed into a 30k load they sound duller. Rarely is an improvement obtained by varying the input impedance from the design value.

Aside from these negative points, the provision of these switches on the rear panel actually degrades the signal-to-noise ratio. If the switches had inherently better shielding the signal-to-noise ratio could be improved markedly on that we quote below.

So far we seem to have made a fair amount of criticism of various features of the amplifier. We do not wish to give the impression that this is a poorly conceived product. Far from it! In fact, the amplifier is a very pleasant unit to drive and it bounds with useful features. It is just that some are open to criticism.

We particularly liked the way in which all controls operated with silky smoothness and there were never any clicks or thumps emitted from the loudspeakers.

Two large PC boards accommodate most of the amplifier circuitry. The larger board accommodates power supply (except for the large filter capacitors), power amplifiers, protection circuitry and the phono preamplifier. The other board accommodates the remainder. A relatively large amount of wiring interconnects PC boards with switches and terminals, but accessibility to the majority of components is good.

The bass and treble control poten-

Creation of the new Calibration Standard filled a need...the acceptance of Stanton's 681 TRIPLE-E is unprecedented!

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As Julian D. Hirsch of Hirsch-Houck Labs wrote in Popular Electronics Magazine in April, 1975: "When we used the cartridge to play the best records we had through the best speaker systems at our disposal, the results were spectacular".

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tiometers are of interest in that their "click-stop" operation is provided by a detented back-plate on the pot itself. Previously where this feature has been provided it has been done with a separate ganged clicker plate similar to those on rotary switches.

Balanced positive and negative supply rails are employed so that the output to the loudspeakers is direct-coupled. Output stages of the amplifiers operate in the familiar quasi-complementary mode. Discrete circuitry is used throughout except for the microphone and phono preamplifiers. A relay is used to mute the loudspeakers at switch-on and switch-off and we assume it also disconnects the loudspeakers in the event of an amplifier failure.

Power rating is 45 watts per channel with both channels driven into 8 ohm loads for a rated distortion of 0.3% maximum over the range 20Hz to 20kHz. A note in the instruction sheet states that where one pair of loudspeakers are to be used they may have impedance between 4 and 16 ohms. Where two sets of loudspeakers are to be used simultaneously, 4 ohm loudspeakers must not be used. This means that the user must endeavour to obtain 8 ohm (or higher) loudspeakers from the beginning if he is not to be limited in their later use.

We might add at this stage, that most amplifier manufacturers with units able to drive two sets of loudspeakers usually stipulate or at least imply that loudspeakers of less than 4 ohms must not be used, so the Rotel is not alone in this regard.

We measured power output 50 watts per channel into 8 ohm loads, 64 watts per channel into 4 ohm loads and 30 watts per channel into 16 ohm loads. Slightly higher powers could be measured when driving a single channel. At no time during our power measurements was distortion over 0.1%, which is an excellent result.

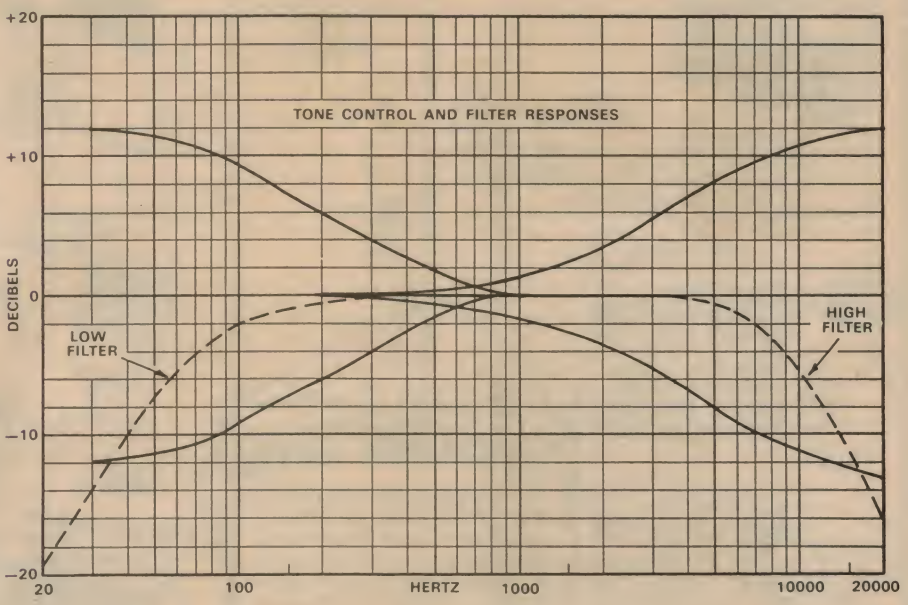
We did strike some difficulty making maximum power measurements into 4 ohm loads as the protection relay tripped in and out because of high heatsink temperatures. This will not worry the normal user though and in fact it is reassuring to know that damage is unlikely due to overheating. During normal tests the amplifier stays cool.

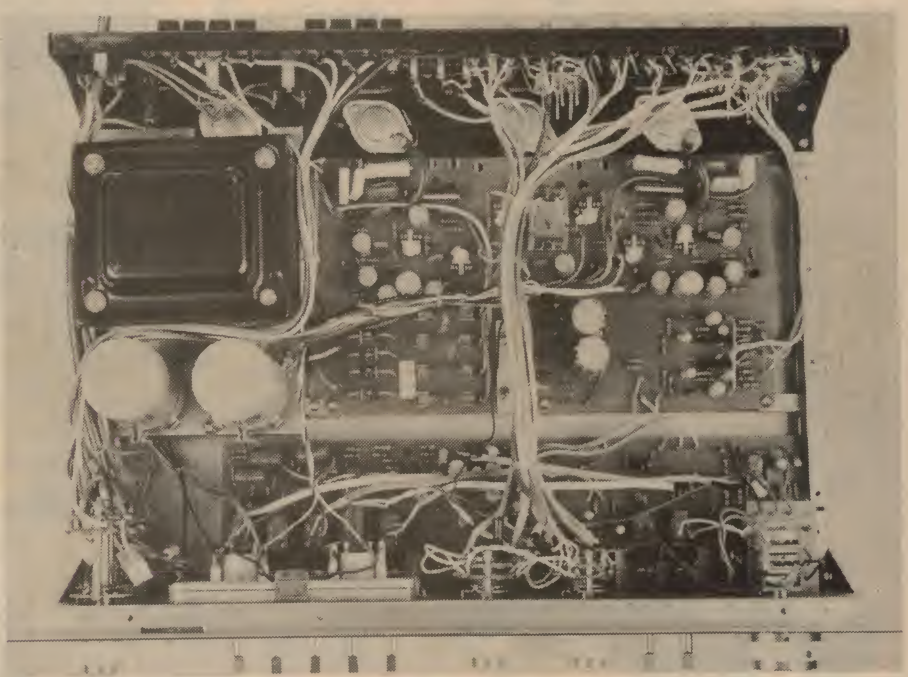
Frequency response at 1 watt checked out with plus or minus 1dB for 5Hz to 45kHz and as noted above, a slightly degraded result is obtained when the Tone Defeat switch is used. This is really of academic interest only. RIAA equalisation for phono cartridges was within plus or minus 0.5dB from 50Hz to 20kHz.

Square wave response and stability with capacitances shunting the load was exemplary. Damping factor exceeds 50, even down below 10Hz! Signal-to-noise ratio for phono inputs was 68dB with respect to full power and an input signal of 10mV, referred to a short-circuit input. This is only a fair result and could be improved as we note above.

Separation between channels at full power into 8-ohm loads was minus 36dB at 10kHz, minus 44dB at 1kHz and minus 43dB at 100Hz. These figures were measured using the high level inputs with the unused input unloaded. Undoubtedly they could be improved by loading the unused input with a typical source impedance such as 10k. As they stand, these results are good.

The various tone control and filter responses are shown in the accompanying diagram. The tone control curves are for maximum settings. We would prefer to see a little less interaction from the tone controls in the midrange region but this is a relatively small quibble. The detent stops on the tone controls give approximate steps of 2dB at 100Hz and 10kHz.





Shown here are the tone control and filter response curves and the internal layout.

At the time of writing this review, we could not quote the recommended retail price for this amplifier but at the price the distributor expected it to be, it would be a very good buy. Further information on the Rotel RA-812 can be obtained from high fidelity retailers or from the Australian distributors, International Dynamics (Agencies) Pty Ltd, 23 Elma Road, North Cheltenham, Victoria. (L.D.S.).

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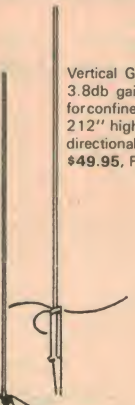

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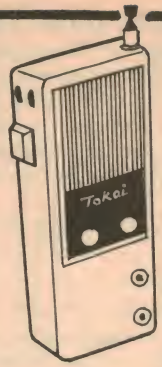

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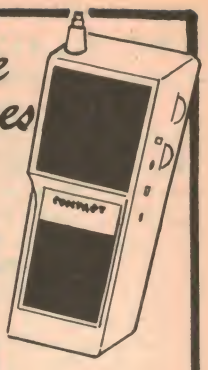

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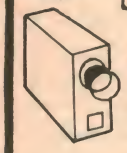

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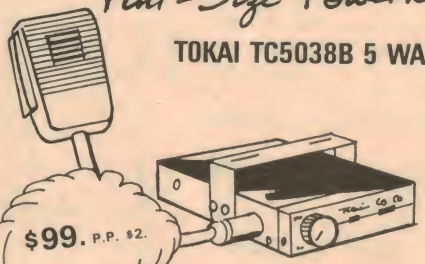

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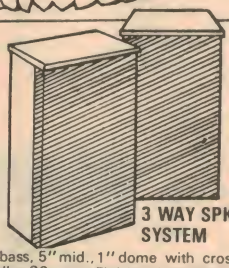
We think this is the smallest 5 watter avail. Only 1⅛" thick, but what a performer. 3 channel facility, squelch, T/mit & stand by lite, remote mike & mounting h'ware supplied. State req. freq.



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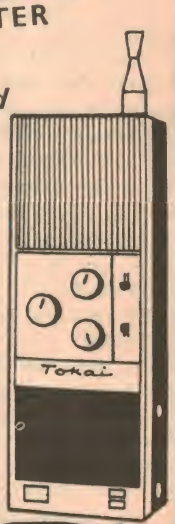

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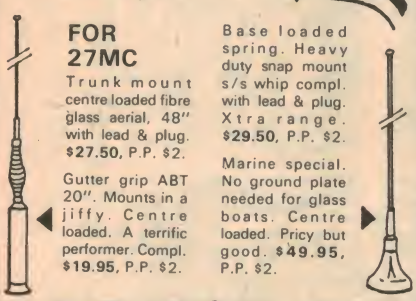

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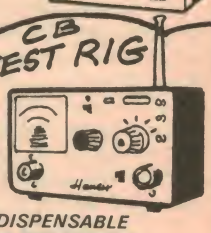

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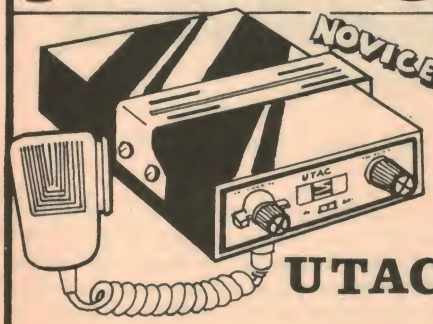

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Yamaha YP-701 Turntable

Last month we reviewed the manually-controlled belt-driven Yamaha YP-450. Here we review a more expensive model, the YP-701. This is also belt-driven and has automatic stop and return of the arm to rest at the end of record play. It is supplied complete with base and cover.

One of the disadvantages of manually controlled turntables is that they do not come to a halt at the end of a record. They just keep "kerwishing" (an onomatopoeic word coined by the reviewer) until in desperation you jump up to turn them off. This can be a drag if you want to doze off. So the YP-701 represents an extra step up in convenience, albeit more expensive.

The appearance of the YP-701 can be described as deluxe. It has an impressive looking diecast baseplate which rests on a timber platform of rather complicated construction. A tinted perspex cover with spring loaded hinges is fitted.

Operating speeds are 33 and 45 rpm. Drive from the motor is taken via a "ground flat" belt to the outer periphery of the platter. This differs from the normal practice of taking the belt drive to an inner rim. The latter practice has the advantage of better decoupling of the "flywheel" of the platter, but results in a very small drive spindle for the motor, which can result in more slip and perhaps more intermittent flutter.

A point to note is that one of the brochures we saw referred to the Yamaha YP-701 as having a "synchronous outer rotor type motor". Instead we found that it has a conventional four-pole synchronous motor which is perhaps a little larger than usual. The motor has a very compliant suspension as does the platter and arm assembly. This results in very low motor noise in the rumble output and effectively decouples the platter and arm from shock such as heavy footsteps on the floor.

We found the adjustment of the height of the lift/lower device (to suit the cartridge fitted) very fiddly. The task was made harder by the small knurled screw which sets the adjustment. A screwdriver adjustment would be preferable.

Another criticism concerns the perspex cover. While the spring loaded hinges hold it in the fully open position, they let it fall with a crash when closed. This can make the arm jump out of the rest. A felt buffer should be fitted at each corner—this would also prevent eventual marking of the timber platform by the cover. Oddly enough, the Yamaha YP-450 reviewed last month was good in this respect.

An attractive S-shaped tone arm is fitted. It has counterweights for balancing in the vertical and lateral planes and a hanging weight system to apply anti-skating force. A viscously-damped lift/lower device is featured and its action is incorporated into the Play cycle. The headshell has the standard EIA locking collar and colour-coded cartridge leads. Slots are provided in the headshell for stylus overhang adjustment. No cartridge is fitted as supplied.

Overall dimensions of the YP-701 are 480 x 161 x 410mm and mass is 9.2kg. Power consumption is 15 watts.

Semi-automatic operation and attractive styling are the big features of the Yamaha YP-701.

Connecting cable from the turntable to the amplifier is about 1 metre long and fitted with RCA phono connectors. Cable capacitance is close to 100pF (in each channel) so a CD-4 cartridge can be connected.

Mode of operation of the player is as follows: Position the tone arm above the track to be played and push the "Play & Off" lever. The platter revolves and the stylus lowers gently into the groove. The cartridge output is unmuted at the last moment so that no extraneous noise is heard from the speakers. At the end of play, the arm returns automatically to the rest and the platter stops. To interrupt play at any stage, just push the Play lever and the player stops as before.

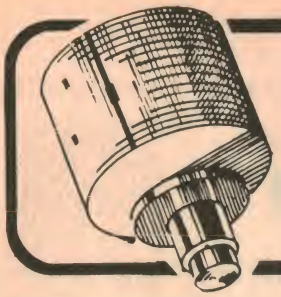
We measured wow and flutter at 0.1% according to DIN 45507, which is a good result. Rumble was 41dB unweighted with respect to 5 cm/sec and with a 6dB/octave roll-off below 25Hz. This again is a good result. Motor noise was very low as noted above. The motor accelerates the platter up to the speed within ½ a revolution, but main bearing friction was not as low as we have seen. More importantly, pivot friction in the arm bearings was low. And stylus tracking force calibrations were within 5% of the mark.

A two-core mains cord was fitted. For a unit in this price range, it should be the standard three-core flex.

Taken all round, the Yamaha YP-701 is a well-built unit with very attractive presentation. It always performs quietly and unobtrusively. Measurements are of a good standard.

Recommended retail price of the YP-701 is $290 including sales tax.

Further information on the YP-701 and other products in the Yamaha range may be obtained from high fidelity retailers or from the Australian distributors, Rose Music Pty Ltd, 17-23 Market Street, South Melbourne, Victoria, or interstate offices. (L.D.S.)



News Highlights

Satellites will update the world's shipping

The future of the shipping industry is looking up—36,000km up to be exact. Space satellites orbiting at that altitude over fixed points on the Earth's surface promise to revolutionise the way ships communicate with the shore and fix their locations.

This is just one of the conclusions drawn from the world's first test of a fully integrated satellite communication and position-fixing system for ships, conducted by General Electric and Exxon Corporation.

The test of the GE system was performed under a variety of conditions over a period of nearly eight months. It involved two NASA geostationary satellites —ATS-1 and ATS-3—and the "Esso Bahamas," a 32,600-tonne oil tanker in service between Venezuela and the east coast of the United States.

The pioneering test enabled Exxon Corporation, which owns and operates its own fleet of oil tankers, to explore the flexibility and economic benefits of satellite communications and position fixing, and to determine how these new services could be introduced smoothly into its current ship operations.

At present, a ship's captain communicates with the shore by sending a wireless message in Morse code to a land-based communications centre, which then relays it to his home office—a procedure that, depending upon atmospheric conditions, can take many hours. In addition, a ship's navigator now plots his vessel's position in open water using techniques accurate only to within a few nautical miles.

By contrast, GE's developmental satellite communication system provided instantaneous and highly reliable voice, teletype, facsimile, and slow scan television communications between the "Esso Bahamas" and Exxon headquarters. The navigational part of GE's system also proved highly successful, plotting position fixes—calculated through satellite range-finding—accurate to within one and one-quarter nautical miles. These fixes were promptly available to both the ship and Exxon's New York City office.

During the communication phase of the test, signals were transmitted by commercial wire between Exxon headquarters in New York City and GE's Radio-Optical Observatory in Schenectady. The signals were then relayed via ATS-3 between the "Esso Bahamas" and the GE Observatory.

The position-fixing phase of the test utilized both ATS-3 and ATS-1. To fix the tanker's location, GE personnel at the Radio-Optical Observatory first computed the precise position of the two satellites, using range measurements from the satellites to GE's worldwide network of fixed, automatic transponders. As a result, this was the first test of a satellite position-fixing system for ships in which the exact location of the satellites was pinpointed at the instant of fixing a ship's position.

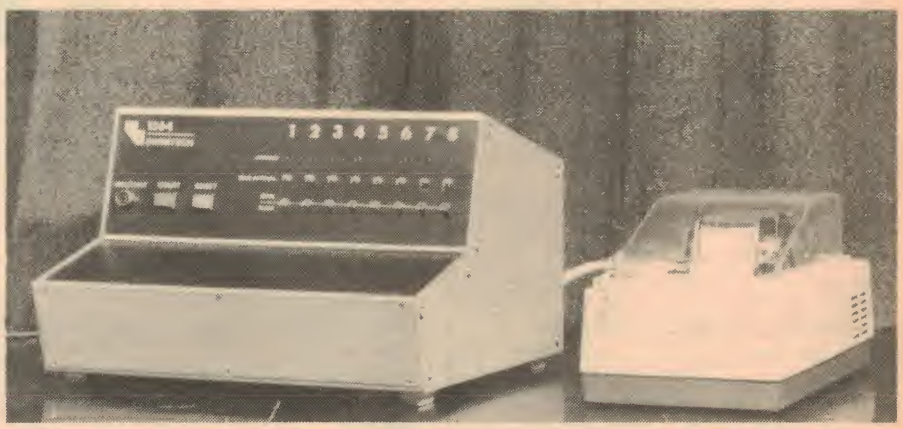
The Observatory then initiated range measurements through the two satellites to the ship. Automatic equipment aboard the tanker responded through the satellites to the Observatory, which used a computer to calculate the location of the "Esso Bahamas." This position fix, calculated in a few seconds, was immediately transmitted back to the tanker and to Exxon's New York City Office.

Swimming pool timer eliminates dead heats

Melbourne-based D. D. Webster Electronics Pty Ltd, a company known mainly for its design and manufacture of computer interfaces and peripherals, is busily developing a new sideline in electronic sporting equipment.

Recently, the company manufactured and installed an automatic judging device at the Valley Pool in Brisbane where many of Australia's top swimming events are staged. It was bought by the Queensland Amateur Swimming Association at a cost of $15,000.

The timer will virtually eliminate dead heats. Similar to the electronic timers used in the Olympics and Commonwealth Games overseas, it works by swimmers touching a pneumatic pad at the end of each lane. As each swimmer touches his pad at the completion of a lap, his lane number, lap number and time in minutes, seconds and hundredths of seconds are committed to a short term buffer memory. This information is then printed out serially to give a permanent record free from all human error.



Competitors with identical times (to within one hundredth of a second) will still be printed out in the correct finishing order as a result of occupying successive locations in the buffer memory.

The unlikely event of two swimmers being so close as to be unresolvable by the machine logic has been avoided by employing a scanning system of finish sensing which checks each lane individually in sequence, at a rate of 100kHz. Swimmers finishing within a single scan sequence lasting less than one ten thousandth of a second are assigned an arbitrary finishing order.

Highly efficient thermal solar collector

A low-cost, highly efficient solar thermal energy collector has been developed at Nasa's Lewis Research Center, Cleveland, Ohio. Lewis Research aerospace engineer Frederick F. Simon and Honeywell's James W. Ramsey collaborated in the design of the new collector which is able to absorb a higher percentage (60% versus 40%) of the solar radiated energy than previous collectors.

An efficient fluid flow design means that the new collector is also able to produce a greater flow of high temperature fluids than was previously possible. Other design features include dual anti-reflective flat glass covers and a black chrome absorption coating. Black chrome is considered the most effective absorption coating known, its use in this role being attributable to Glen E. McDonald, also of Lewis Research.

According to NASA, the new collector can be produced at a cost comparable to present commercial collectors. Main application is in providing heating and cooling requirements for buildings and homes, thereby greatly reducing fuel costs and pollution.

Telephone calls via optical glass fibres

In London, the British Post Office has given an impressive demonstration of the potential of optical fibre communications. During the demonstration, telephone calls were sent over an optical glass fibre no thicker than a human hair.

The system demonstrated shows the advanced position which British Post Office research teams, working in collaboration with commercial interests, have established in this field. Already as many as 2,000 telephone calls can be carried on each strand, and experts believe that this could be increased to 200,000 in the near future.

Cables made from glass fibre instead of wire could eventually be used in many parts of the telecommunications network—from long distance trunk transmission to local television distribution into people's homes. Major advantages offered by glass fibre cables include potentially significant space savings coupled with the ability to be drawn into existing cable ducts, and the ability to transmit signals for a greater distance over the cable before it becomes necessary to re-boost the signal.

Two systems were shown in the London demonstration—one capable of sending up to 120 calls at once over a single fibre section 4km long without intermediate amplification, and the other capable of sending 2,000 calls over a fibre 1km long installed in the cable ducts of a normal building.

Dick Smith staff in city street demo

. . . accuse Tandy of unfair business practice

Amidst charges of unfair business practice, employees of Dick Smith Electronics Pty Ltd staged a noisy demonstration outside the York St, Sydney, store of Tandy Electronics on the 28th October, 1975. The demonstration coincided with a press conference called by the US owned Tandy Electronics group to announce a new profit sharing scheme.

In all, some 40 employees of Dick Smith Electronics took part in the demonstration outside the Tandy store.

The employees claim that Tandy is engaging in unfair business practice in order to squeeze out the specialist Australian retailers and gain market domination. To achieve this, they say, Tandy is prepared to suffer considerable losses during initial operations, and then use market domination to regain lost profits.

Tandy's "front loading" tactics threaten the present Australian free enterprise market, according to Dick Smith staff. They claim that market domination by Tandy will severely restrict the range of products and components available to the Australian consumer, and adversely influence prices.

Mr Warren Pigott, a buyer for Dick Smith Electronics said that Tandy has already influenced some overseas suppliers who now refuse to cater for the small Australian retail outlets. He said the local retailers were quite prepared to compete with Tandy, provided it was a free and open market.

Initial investment by Tandy Electronics in Australia is said to be of the order of $10 million. The company is believed to have suffered a $500,000 loss during its first six months of operation.

First Australian ship-to-shore telex messages

Telex operator Irene Margelis with Australia's first maritime telex message.

The first maritime telex messages between Australian subscribers and ships at sea were transmitted at the end of September. The messages were part of a full-scale testing program of the maritime telex service, scheduled for introduction by OTC at the beginning of November.

First contact was established on September 24, between the container ship, "Abel Tasman", off the West Australian coast, and the ANZ Bank's telecommunications complex in Martin Place, Sydney. On the same evening, calls were established between the P & O passenger vessel, "Pacific Princess", cruising off Mexico, and P & O's offices in Sydney and London.

The new telex service will enable ships almost anywhere in the world to establish telex contact through OTC's Sydney radio installation and be interconnected to telex subscribers anywhere in Australia or overseas.

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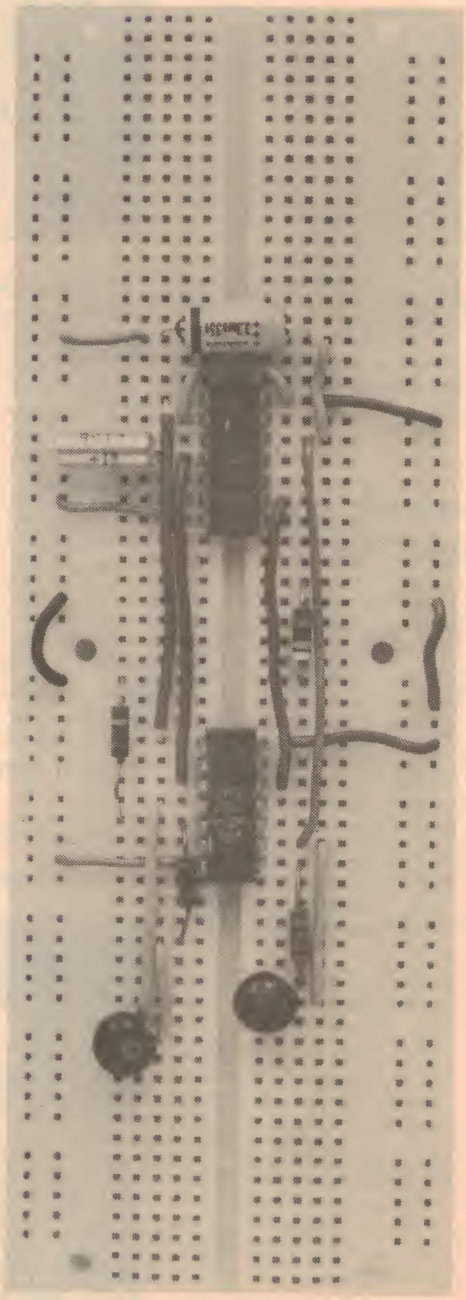

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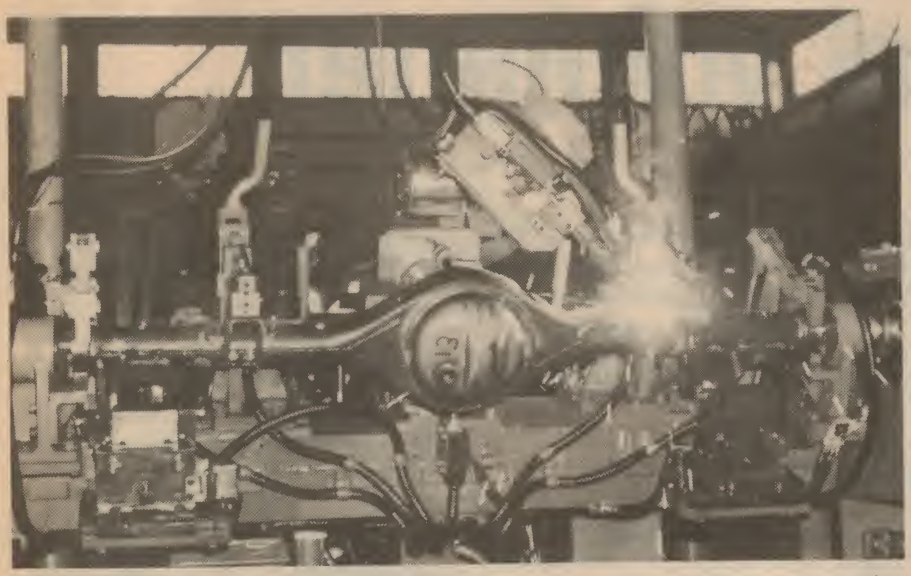
NEWS HIGHLIGHTS

Robot automates production line welding



A new model of the Unimate industrial robot has been released onto the Australian market by distributors Gollin & Company Ltd. Known as the Robot Inert Gas (RIG) system, it is designed to automate continuous wire inert gas welding on flat, simple curved and compound curved workpieces.

The RIG system can be programmed to move the welding gun in as many as six axes simultaneously, automatically moving between taught points to yield a smooth continuous path. In addition, it can be used on production runs of varying lengths. Rapid re-programming facilities allow a new welding pattern to be taught in minutes.

A new welding job is taught to the robot by switching the Unimate to the recording mode and leading the robot through the welding cycle. Once recorded, the automatic welding sequence is played back repeatedly and precisely as each new workpiece is presented.

Up to 40% improvement in welding time has been found with the Unimate RIG system as compared to previous manual welding methods.

GE develops fast PCB manufacturing technique

A rapid and inexpensive technique for fabricating printed circuit boards promises to make General Electric one of the world's largest quantity producers of these key electronic components within the next 12 months.

By means of GE's new technique, which required the invention of a special conductive ink and a revolutionary high-speed production system, millions of circuit boards already have been manufactured by the company, with production scheduled to reach tens of millions of units annually.

One such circuit board is incorporated in each of the millions of "FlipFlash" photoflash arrays that GE is now marketing. The circuits will conduct electricity to the eight flashbulbs and—in combination with special switches developed by GE scientists—control the sequence of firing.

"Traditional methods of fabricating printed circuits, such as etching or die cutting, were too slow or too costly—or both—to meet our goals," said Dr Arthur M. Bueche, GE vice-president for research and development.

"The only feasible alternative appeared to lie in the area of screen printing, a process by which a conductive ink can be printed rapidly onto a substrate material," the GE executive added. "But conventional conductive screen-printing inks are too expensive. They also are slow to dry, usually making it necessary to bake printed parts in ovens that consume large amounts of energy."

To meet this challenge, GE chemists set out to invent an inexpensive, fast-drying conductive ink that could be applied by a screen-printing process and dried in a matter of minutes. The result of an intensive research program was the development of a proprietary resin solution that meets these specifications.

The conductive ink is automatically screen-printed in circuit patterns on low-cost substrates. Total production time for GE's circuit boards, from screen printing through curing, is only a few minutes, compared with up to 60 minutes for printed circuits made by conventional techniques.

Radiopaging service for London in 1976

A contract to supply 10,000 radiopaging receivers has been placed by the British Post Office with the Multitone Electric Company. The pocket "bleepers" are for London's radiopaging system, a new Post Office service for contacting people on the move. It is to begin service at the start of next year.

The bleepers are a slim 130mm long by 53mm wide by 16mm thick and weigh 140 grams. They can be clipped into the pocket or can be slipped easily into a lady's handbag. Two clearly distinctive bleep tones are used to distinguish between callers, for example to tell whether the call is from home or from the office.

At times when a paging call could cause disturbance—for example, when a doctor is visiting a sick person—the pager can be switched to 'memory'. This stores the incoming call until the pager is switched on again. Calls to pagers in London will be possible from anywhere in Britain, in most cases by direct dialling.

The Post Office decision to provide a radiopaging service in London follows a successful trial in the Thames Valley. The London scheme will cover 900 square miles, from Potters Bar in the north to Coulsdon in the south, and from Heathrow eastwards to Dartford, Kent. Eventually the service will be able to cater for up to 100,000 users.

US experiments for Soviet satellite

For the first time in history, US experiments will be flown on board a Soviet spacecraft.

Dr David L. Winter, NASA Director for Life Sciences, announced recently that during the recent Joint US/USSR Working Group meetings on Space Biology and Medicine, plans were completed for US experiments to be carried on an unmanned Soviet biological satellite expected to be launched late this year.

Four NASA-developed life sciences experiments are scheduled to fly, in addition to seven tissue investigations to be conducted by US scientists on materials supplied by the Soviets from animal experiments.

NASA's Ames Research Center, Mountain View, California, is managing three of the flight experiments—concerning plant cell culture, plant tissue growth and radiation—and all the tissue investigations. Johnson Space Center, Houston, Texas, is managing a fish egg development experiment.

The US experiments will be passive—completely autonomous from the spacecraft power, telemetry and data recording. They will be housed in five Soviet fabricated containers measuring 178 x 127 x 115mm. These packages will be returned to US scientists at the completion of the flight.

Andrew Kay—inventor of the digital voltmeter

Ever heard of Andrew Kay and Non-Linear Systems? You haven't? Well, Andrew Kay is the man who invented the world's first digital voltmeter, and Non-Linear Systems is the company that he founded—a company now recognised as a world leader in the design and manufacture of digital instrumentation. This article looks at Andrew Kay's unique formula for success, and describes the latest low-cost digital multimeters developed by his company.

by GREG SWAIN

Non-Linear Systems (NLS) was formed in 1952 by Andrew F. Kay, then a new graduate of the Massachusetts Institute of Technology, to manufacture the world's first digital voltmeter. Initial offices were located in Del Mar, but the company later moved to a seven-building complex at Del Mar Airport. It was here that an atmosphere of creativity fostered the innovative engineering which vaulted NLS into the leadership position in the digital instrumentation field.

Under Andrew Kay's dynamic leadership, the company grew to a point that demanded larger facilities. New facilities, containing in excess of 56,000 square feet and covering 5 acres of a 21-acre site, were designed and built in Del Mar in a way that affords an expansion capability while at the same time maintaining a pleasant atmosphere.

All buildings of the modern 16-building Del Mar site are constructed of wood and glass, providing every room with a view of the campus-like landscaped areas surrounding the buildings. Here company engineers work in an atmosphere where they are free to think and design in a creative way. The results speak for themselves.

The company itself is a diversified organisation now marketing a product range that includes digital voltmeters, digital data acquisition and computer systems, pressure meters and generators, medical electronic equipment, educational aids, and semiconductor test equipment. The emphasis in all these product areas is product reliability and quality, customer satisfaction, and service.

NLS has a very good claim to the leadership position in the digital instrumentation field, the more so when this claim applies to digital measuring equipment.

It was Andrew Kay who designed and built the world's first digital voltmeter, a 4-digit device, in 1952. Since then the company which he founded, and of which he is now president, has been the leading innovator in the field of digital voltmeter and digital multimeter design.

Andrew Kay—founder and president of Non-Linear Systems.

NLS has designed, built and delivered digital instruments to well over 10,000 different customers in over 50 countries since Andrew Kay developed that first digital voltmeter in 1952. Now noted for its high reputation, both in products and in the manner of doing business, the company has for years supplied quality, high-performance instruments to industry and government agencies.

Much has been written about the leadership and directive talents of Andrew Kay. He has provided NLS with twenty three years of consistent, dedicated direction and leadership, and it is his unique style of company management that has contributed more than anything else to the company's success. His leadership has not only preserved the company's reputation as a producer of high-quality digital meters, but has also earned him a reputation as an authority on company management.

Kay's formula for success is simple enough. As a businessman, he staked his company's future on the belief that people will perform far better if entrusted with important responsibilities. This philosophy has manifested itself in

The world's first digital voltmeter, developed by Andrew Kay in 1952.

a mutually beneficial employer /employee relationship that has made NLS products leaders in quality and reliability.

In fact, so successful have Andrew Kay's managerial techniques been that he has been called upon to counsel companies many times the size of Non-Linear Systems in the area of management philosophy. In diversifying the efforts of his own company, he has used his profound understanding of people and industry to the fullest. According to Andrew Kay, "there is nothing like the challenge of responsibility to bring out the best in human nature."

NLS has built up an impressive lists of world firsts along the road to success, many of these in the digital voltmeter (DVM) and digital multimeter (DMM) fields. In addition to the first DVM in 1952, NLS can boast these firsts: a digital ohmmeter in 1953; a five-digit DVM, also in 1953; a dry relay A/D converter in 1955; a 4-digit digital millivoltmeter in 1957; a 4-digit multimeter providing DC volts, ohms and ratio measurement capability in 1958; the first 4-digit DVM to sell for under $1,000, again in 1958; an all solid state DVM not requiring trim pots for stability in 1960; a 4-digit deviation ohmmeter, a recording DVM, and a 5-digit multimeter, all in 1961; the first fully automatic solid-state DVM in 1962; a 6-digit ohmmeter in 1964; and the first 3-digit all electronic multimeter at a price competitive with pointer type meters in 1968.

The list is in addition to a number of impressive technical achievements made over the years, and is by no means complete. It is no exaggeration to state that technological breakthroughs made by NLS engineers have played a major role in the shaping of the DVM industry as we know it today.

But it is not only technological innovation that has earned NLS a deservedly high reputation in the digital instrumentation field. Equally important is product reliability, and this has been achieved by a no-compromise approach to manufacturing. Only high quality components and materials are utilised (eg all printed circuit boards are fibreglass) and manufacturing personnel work in small teams rather than production lines. The result—pride in workmanship.

In all NLS instruments, modular construction techniques are employed, allowing for fast, easy assembly with less chance of error and easy serviceability. Final check-out and calibration of each instrument is completed only after a burn-in period at elevated temperatures. In addition, each instrument is put through a shake test, resulting in an equipment return rate claimed by NLS to be the lowest in the industry.

Pride in workmanship is evident even in the company's lowest priced DMM, the LM-3. Recently launched onto the Australian market the LM-3, in company with its big brother the LM-4, has already stirred up a great deal of local interest. Andrew Kay even visited Australia to help promote the new miniature DMMs together with two miniature digital panel meters (DPMs), the 3-digit PM-3 and the 4-digit PM-4.

The LM-3 and LM-4 DMMs are truly impressive instruments, the more so when size is taken into consideration. Hand soldered fibreglass boards hold state-of-the-art MOS/LSI circuits in units less than 2 in high (both models share the same case size), which can be dropped without ruining either case or calibration. In fact, there is no zeroing adjustment on either instrument, this function being completely automatic—as is the polarity indication.

Considered separately, the LM-3 is a full 3-digit, full function multimeter that sells in Australia for $99 plus tax, including rechargeable Ni-Cad batteries and a battery charger. Abridged specifications include: 4 DC voltage ranges to 1kV; 4 AC voltage ranges to 1kV; and 5 resistance ranges to 10 ohms. Maximum input on any DC voltage range is plus or minus 500VDC, or 500V RMS on any AC voltage range.

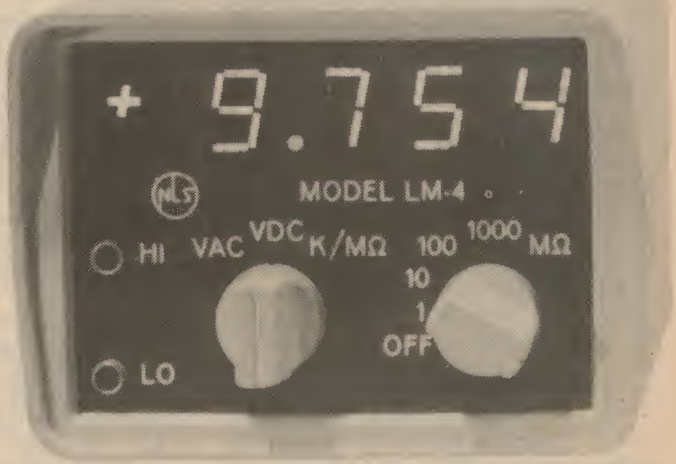
On both DC voltage and resistance ranges, accuracy is quoted at plus or minus 1.0% of reading plus or minus 0.1% of range full scale. On AC voltage ranges, accuracy is plus or minus 1.0% of reading plus or minus 0.1% of range full scale from 50Hz to 400Hz, with reduced accuracy outside these frequency limits. Resolution varies from 1mV to 1V on both DC and AC voltage ranges, and from 1 ohm to 10 kilohm on resistance ranges.

The big brother 4-digit LM-4 sells for $180.00 plus tax. It features 5 DC voltage ranges to 10kV, 5 AC voltage ranges to 10kV, and 5 resistance ranges to 10 megohm. As with the LM-3, the maximum input on any DC voltage range is 500V DC, or 500V RMS on AC ranges.

Resolution for the LM-4 is a factor of 10 better than the LM-3 for all ranges, whilst accuracy is also enhanced. Unlike the LM-3, the LM-4 is available in two models: a mains powered version, or a battery powered version. Only one version of the LM-3 is available and this is battery powered. An 8mm high LED readout display is employed in both cases, the PM-3 digital panel meter in the LM-3 and the PM-4 in the LM-4.

Specifications common to both the LM-3 and the LM-4 (in addition to automatic polarity selection and automatic zeroing as mentioned above) include: 10 Megohm input impedance; manual range selection; overload indication (10000 LM-4, 1000 LM-3 with numeral "1" flashing); an operating temperature from 0-45°C; and built in overload protection. The decimal point is automatically positioned by the range switch. Case dimensions are 2.7 x 1.9 x 4.0in (W x H x D), and weight is just 9.2 ounces (with batteries).

A range of optional features are offered with the LM-3 and LM-4 DMMs. These include: a 30kV high voltage probe; five current shunts (100uA to 1A, 1V range) a universal test lead set; faster sampling update (4 readings per second); a leather carrying case; a carrying handle/tilt stand; and a panel-mount flange. In addition, rechargeable Ni-Cad batteries and a battery charger are optional on the LM-3.



The LM-4 digital multimeter. Main features include 5 DC, 5 AC and 5 resistance ranges; automatic polarity selection; automatic zeroing and decimal point positioning; overload indication; and full overload protection.

The LM-3 and LM-4 DMMs are two very fine examples of the NLS approach to high technology engineering—this despite the fact that they are at the bottom of the NLS product price range. Innovation has been related not only to the latest technology, but also to value engineering to provide performance and quality in the smallest size available at an attractive price.

There are perhaps many factors accounting for NLS's leadership in the design and construction of digital measuring instruments. But undoubtedly the greatest factors have been the willingness of NLS to contribute time and money to make the company a good place to work and, of course, Andrew Kay's leadership.

The Lightwriter—a new "voice" for the mute

Electronic technology is coming to the aid of the handicapped in all sorts of diverse ways. In England an engineer, himself severely handicapped and unable to speak, has invented an effective new communications system for the dumb. And he has set up a company to manufacture and market the new system.

by ALAN DAWLISH

Toby Churchill was about to start a promising career as an engineer when, at the age of 21, he was struck by an unknown virus. The illness left him paralysed down his right side and robbed him of his ability to speak. Fortunately, Toby's brain was unaffected and he was able to continue his studies, graduating from Bath University with a B.Sc in engineering.

Toby's biggest problem was to communicate with people. Being naturally right-handed it took him some time to learn to write left-handed messages, so he was initially forced to use the cumbersome alphabet card system of "talking." Subsequently, Toby found that he could effectively use an electric typewriter with his left hand and it struck him that a machine like this could provide the answer to his communications problem.

In order to stay abreast of developments in the engineering field, Toby reads whatever he can in the way of scientific and engineering publications. Reading through one of these publications one day, his attention was drawn to a small digital display unit belonging to Burroughs (USA) Self-Scan panel range. By combining the keyboard functions of an electric typewriter with the Self-Scan panel, his communications problems would be solved.

With the aid of three friends, Toby designed the "Lightwriter." The unit which measures only 30 x 23 x 7cm and weighs only 2.5kg, consists of a typewriter-type keyboard behind which is fitted the readout panel. The panel may be tilted either towards the operator or towards the viewer, or can be lifted from its housing for display at a remote location.

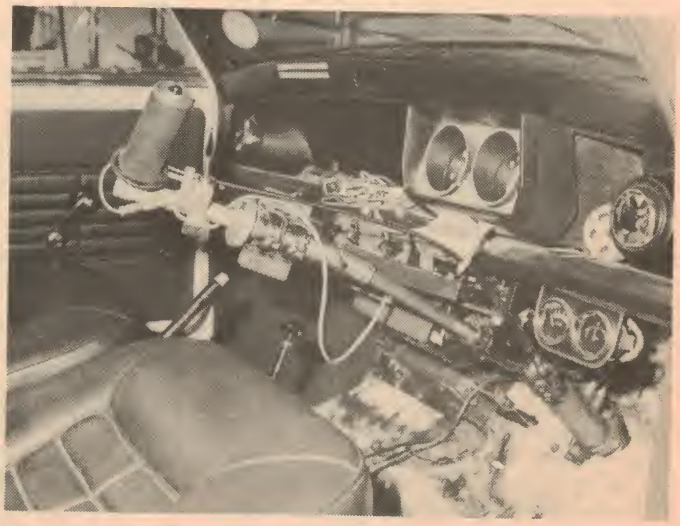
When a key is pressed, the corresponding letter appears on the readout panel. The letters move from right to left across the panel, which is capable of displaying a 32 character per line message. The panel can thus display a complete phrase long enough for it to be read, the letters disappearing at the left hand edge of the display more or less like a newscaster display.

Toby Churchill with Harry Lowe, one of the team who helped build the Lightwriter.

A special backspace key is fitted in order to correct a typing error. This key moves the entire line back one space, removing the last letter. Another key removes the entire line.

The prototype has proved so successful that Toby Churchill, together with his three compatriots, David Battison of the Medical Research Council and Harry Lowe and Tim Gosling of the Cambridge

The Lightwriter enables two dumb people to communicate, even if they do not have full use of their arms.



The interior of Toby Churchill's modified Mini car. All modifications are according to Toby's own specifications.

University Engineering Department, has formed a company to manufacture and market the Lightwriter. The company, called Toby Churchill Ltd, is geared to supply the new communications aid as demand requires.

Initially, the Lightwriter, which is powered by rechargeable batteries, will market for around £200. However if demand is such that efficient mass production techniques may be employed, the cost will come down.

Today, Toby Churchill is able to "talk" about the ideas that continually fill his engineering mind. He now spends his time designing and developing aids for other handicapped people.

One of Toby's most impressive achievements is the adaption of the controls of his Minicar, which he is now able to drive using just his left arm and hand. The modifications to the car, shown in the accompanying photograph, are entirely to Toby's own specifications and ideas.

Basically, most of the control functions are mounted on, or controlled by, a single column. At the top of the column is fitted a motorbike-type accelerator

All controls in the modified Mini can easily be reached with one hand.

hand grip which is used to control the speed of the car. This grip is mounted at right angles to the column, just in front of the turn indicator switch. To steer, the grip is turned to the right or to the left, thus turning the column to the right and to the left. Braking is accomplished by pulling the entire column down towards the driver's lap.

Control functions remote from the column are fitted so that they are within easy reach. These include the handbrake and the gear selector lever (the Mini is an automatic). The starter button is fitted near the door so that Toby starts the car on entering the vehicle.

The design is so basic and easy to use that with the help of a manufacturer this unit could well replace the conventional steering wheel now fitted to motor vehicles. By centrally locating the unit within a vehicle, injuries to drivers would be reduced in the event of an accident.

Toby now has several new ideas up his sleeves, but until he has perfected them they will remain a secret. One thing is certain—where human ingenuity and courage are concerned problems will be solved, no matter what the odds.

For the next era of manned space flight . . .

The hunt is on for Spacelab scientists

The Space Shuttle, now under development by the National Aeronautics and Space Administration (NASA), will open up a new era in space flight—an era that will make relatively low cost space flight possible for the first time. The European Spacelab is an important part of the Space Shuttle program, and tests are now underway to determine which scientists are most suitable for manning the Spacelabs.

by DR JOHN GRIBBIN*

An international crew of scientists has recently completed a six-day mission aboard a jet aircraft set up to simulate the conditions of spaceflights in the 1980s which will carry scientific experiments in Spacelab, Europe's space laboratory.

Spacelab will be carried into orbit by the American Space Shuttle and returned to Earth by the Shuttle after each mission so that it can be reused.

The laboratory is being designed and built by the European Space Agency (ESA) and will carry a variety of scientific experiments. The jet mission, given the code name "ASSESS", was designed both to test the kind of equipment envisaged for these experiments and, perhaps even more important, to find out how best to use the Spacelab facility.

The laboratory will carry many experiments but only a handful of operators, so it is quite unlikely that the operators will be the scientists who designed and built the experiments. So who is likely to be best at the job?

On the ASSESS aircraft there were six experiments, all making observations which would be impossible from the ground. Infrared detectors provided by teams at Queen Mary College, London, and the University of Southampton in southern England are typical of the kind of equipment which can only make worthwhile astronomical observations from above the bulk of the obscuring water vapour in the Earth's atmosphere.

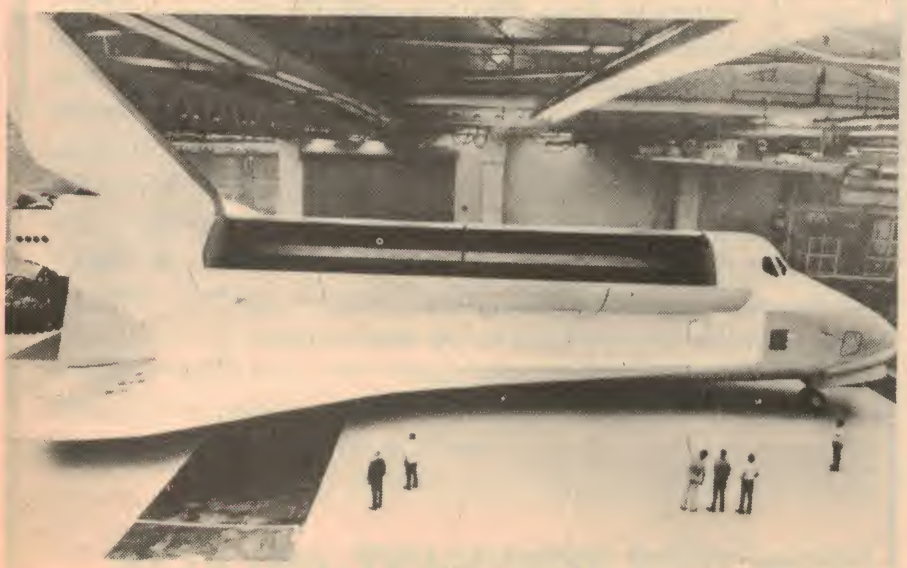
During the mission four operators flew with the experiments for six hours each night. On the ground between flights they were kept in a small room, able to communicate with their colleagues only by telex and telephone. The idea was to simulate the kind of dependence on their own resources which would occur had it been a real spaceflight of six days.

The ideal operator would be a scientific "jack-of-all-trades" who would be comfortable under such conditions. So NASA and ESA chose four operators with very different backgrounds for their trial team.

One was an experienced astronaut, one an experienced scientist, another a scientist with a great deal of experience flying his own aircraft. But the most successful of the four operators was Nick Wells, a young research student from the University of Sussex in England.

Mr Wells has, of course, a scientific background, although as yet very little experience. It looks rather as if the adaptability of youth is more important for this kind of work than a great deal of experience.

* "Nature" science magazine, London.



View above shows a lifesize mock-up of the Space Shuttle Orbiter. At right, Dr David Shapland at ESA headquarters in Paris shows a model of the Orbiter with Europe's Spacelab tucked inside. The real thing should be in orbit in 1980.

Background notes to NASA's Space Shuttle program

NASA's Space Shuttle will be a low-cost reusable space vehicle, designed primarily as a transportation system for a wide variety of space missions in low Earth orbit.

The Shuttle will deploy scientific and applications satellites of all types, as well as the European designed Spacelab project.

The Shuttle will consist of a reusable Orbiter, mounted "piggy back" at launch on a large expendable liquid propellant tank and two recoverable and reusable solid propellant boosters. The Orbiter will look like a delta-winged airplane, about the size of a DC-9 jet liner. It will have three liquid fuelled rocket engines, a cargo bay 18 metres long and 4.5 metres in diameter, and will be operated by a crew of three.

Present schedules call for horizontal flight testing of the Shuttle in 1977, orbital test flights in 1979, and full operational capability by 1980. The Orbiter, with its crew and payload is designed for a normal mission of about seven days, and this can be extended to as long as thirty days when required. At the completion of a mission, the Orbiter will return to Earth and land like an airplane.

The Spacelab is being developed in Europe under the auspices of the European Space Agency (ESA). In all, some nine European countries are involved in the project and these include Belgium, France, Germany, Italy, The Netherlands, Spain, Switzerland and the United Kingdom.

Designed to meet the requirements of a broad spectrum of science, the Spacelab will be the means by which man-associated experiments are carried out in the Orbiter payload bay. It will have two important elements: a pressurised manned laboratory which will permit engineers and scientists to work in a "shirt-sleeve" environment; and an instrument platform, or pallet, to support telescopes, antennae, and other equipment requiring direct space exposure.

As with the Orbiter, the Spacelab is being designed around a basic seven-day mission, this being extendable up to 30 days by trading off payload weight and volume for the consumables necessary to accommodate the additional time in orbit. Current plans visualise that about 38 per cent of all potential Shuttle missions will involve Spacelab, with the remainder involving the placement, revisit, or retrieval of automated spacecraft.

Aged 25, Wells is now working on studies of plasma physics which are relevant to understanding the ionosphere which surrounds the Earth. He has previously worked on rocket experiments investigating the ionosphere.

Britain has close links with the planning of Spacelab missions, and indeed many Britons work at the ESA headquarters in Paris. One is Dr David Shapland, a Welshman who has been working on the Spacelab program since is began.

According to Dr Shapland, the simulation part of the ASSESS project has gone very well and has provided just the kind of information that ESA and NASA were hoping for about managing a project like Spacelab and choosing the operators to fly in it. He points out that all the experiments flown on the mission are very real research projects in their own right and that to take full advantage of the availability of the aircraft research teams have been making extra flights since the ASSESS mission itself ended. So as well as helping to plan Spacelab operations, the mission is also producing valuable scientific results.

The schedule now is one of steadily increasing activity leading up to a first Spacelab flight in 1980. The laboratory itself will carry a total payload of between 5500kg and 9100kg, depending on the configuration chosen for particular missions, and it will be put into orbit at altitudes up to 500km.

The laboratory will come in two modular forms, to fit in with other cargo carried by the Shuttle: a short module will be 4.4 metres long, a second 6.9 metres long. Both will have a diameter of 4 metres. The whole system is designed to be as much as possible like a laboratory on Earth, and will be loaded complete into the Shuttle for each flight.

On the first flight, scheduled for 1980, a lot of space will be devoted to test equipment. But even then there will be room for a scientific payload of 3000kg using up to 1.5kW of electrical power. Later this year ESA will be examining detailed proposals from a selected handful of 250 applications from scientists who want to contribute to the experiments. These include proposals from the Southampton and Queen Mary College teams involved with the ASSESS mission.

One interesting possibility, especially in International Women's Year, concerns the sex of the operators chosen to fly with Europe's space laboratory. Dr Shapland confirms that operators are to be chosen solely on grounds of ability and aptitude so women are welcome to apply.

And if they have as much aptitude as Nick Wells they are likely to get a flight in space.

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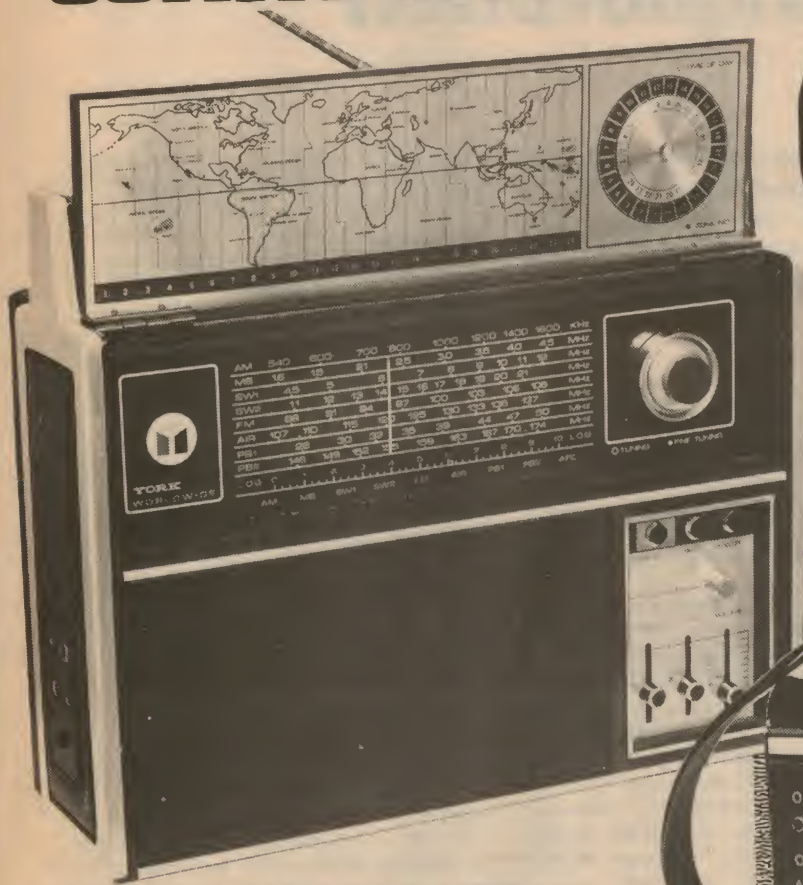

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Remote controlled vehicle for undersea exploration

Secrets of the mysterious world beneath the sea are being unfolded as new and more versatile submersibles are developed to assist in undersea work. One of the latest submersibles, designed specifically for exploration and inspection tasks, is Britain's remote controlled CONSUB, the first of a new generation of undersea machines.

by JOHN HOGAN

Although ahead of its time when it first caught man's imagination, the world of Jules Verne's "Twenty Thousand Leagues Under the Sea" is very much close to reality these days. Submarines and other submersible vehicles, both manned and unmanned, are now providing us with a detailed knowledge of life in the sea, as well as performing all manner of useful undersea tasks.

There is growing interest in what goes on and what things look like under the sea—and even serious talk of turning parts of the seabed into farmland for food production. Underwater exploration and inspection is thus becoming increasingly necessary, chiefly to meet the world's urgent demands for new sources of energy and to provide speedy and reliable communications between nations.

Now, moving with almost silent and eerie purposefulness in the vastness of the sea and submerging to depths up to 600 metres is the latest machine created and constructed by British scientists and technicians. Known as CONSUB—a convenient contraction of its full title, Continental Shelf Submersible—it came into official workday use in mid-April 1975 after undergoing extensive trials on Scottish geological sites near the Orkney Islands, the Shetlands and the Moray Firth, and in the Hardanger Fjord in Norway.

CONSUB was designed by the Electronic and Space Systems (ESS) Group of the British Aircraft Corporation (BAC) at Filton, Bristol, in western England, and is the first British underwater machine of its kind. It was built to the order of the Institute of Geological Sciences' Continental Shelf and Geophysical Division in Edinburgh and possesses the following vital statistics: weight 1.2 tonnes; length 2.4 metres; width 1.8 metres; motive power 15kW (20hp); underwater speed 2½ knots.

Intended as a sophisticated tool for all types of undersea engineering and offshore energy tasks, CONSUB is officially described as an unmanned remotely controlled seabed exploration vehicle. It is equipped with TV cameras capable of scanning in all directions, and is controlled by a three man "crew" operating at a remote location, either on board a ship or on shore. Floodlights are used to provide illumination for the TV cameras, while power for the four propellers comes from an electro-hydraulic system via an umbilical link with the control station.

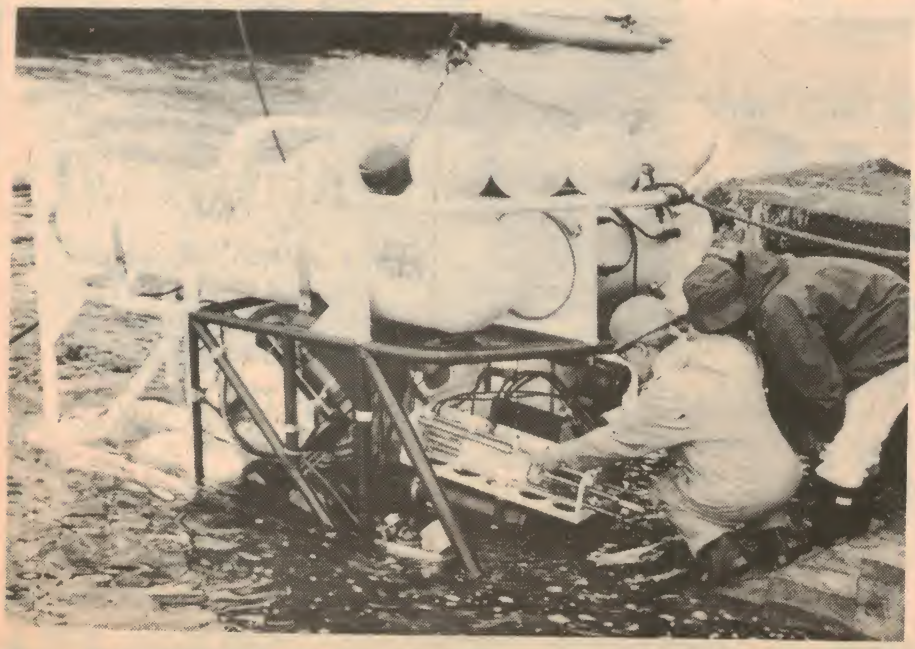
CONSUB was thoroughly tested in northern waters during Britain's winter months at the beginning of the year, emerging with flying colours. Operated from the research ship "Challenger", CONSUB submerged to depths ranging up to 85 metres, and ranged as far as 250 metres from the mother ship. These dives took CONSUB and its inquisitive "eyes" over beds of sandy mud and rippled sand, over small boulder fields, and over rocky outcrops.

On some occasions CONSUB was deeply submerged for five hours at a time, and did all that was asked of it. Everything seen through its two television cameras was recorded on videotape. "It was found to be very easy to control and could be positioned within inches," said one of the team of experts who put it through its paces.

BAC's head of electronics sales, Mr F. C. Goldthorpe, says that pleased and satisfied as they are with the result of their two years' work on CONSUB they are already moving to second and third generation equipment. "The need for such machines is obvious," he said.

"In a year's market survey I found that the most immediate requirement was for a machine that would seek and find features on the seabed and perform fairly detailed inspection tasks. CONSUB does all this. It can hold its position in adverse conditions with currents of up to two knots, it can follow pipelines and cables, drill small rock samples for later examination in geological laboratories, and in general weigh up the undersea scene from all angles."

"Machines such as CONSUB eliminate danger to humans and save enormously on time and other factors. There are 5600km of pipelines in the North Sea and oil companies have to inspect their pipelines twice a year. For all these reasons, and not forgetting undersea



View at left shows CONSUB during trials held earlier during this year. The new underwater machine is now fully operational.

power and telephone cables, we see ourselves ending up with a family of deepsea machines doing a variety of jobs."

BAC's ESS Group is already well advanced with the design of a new "relative" for CONSUB. Called SCARAB, the new machine is being designed as the result of a proposal by International Cable Consortium Ltd, and involves British, American, Canadian and French interests. SCARAB will be capable of submerging three times as deep as CONSUB, its chief function being to locate and repair faults in submarine cables.

In the meantime, CONSUB will be available for general diving inspection tasks—that is, when it is not carrying out work for the Natural Environment Research Council. These operations will be managed by BAC's Electronic and Space Systems Group. In this way, CONSUB should make an important contribution to our understanding of undersea processes, as well as performing valuable inspection service of a commercial nature.

Computers will automate shopping

Long checkout lines and familiar grocery carts could be replaced by pushbutton electronic shopping if techniques already existing were applied to the retail food industry, a Massachusetts Institute of Technology study indicates. The report, funded by the National Science Foundation, offers alternatives to present shopping patterns now governed by the supermarket system.

The report cited four options for tomorrow's supermarket system and called them collectively the "electronic age of food shopping". They are the highly automated warehouse-to-door shopping system, highly automated retail superstores, automatic minimarkets and mobile automatic markets.

Warehouse-to-door shopping, in which the expensive retail store is eliminated, has met with mixed success in the few places it has been tried, but an electronic system remains to be developed, according to the report. At least two technical problems require solutions: the design of the automatic order-taking and order-selection equipment, and the design of the home terminal from which orders are placed. The home terminal could be compatible with telephone equipment or have communications links with cable television.

The automated retail superstore concept initially places all non-meat and non-produce merchandise "behind the scenes" and centres the shopping process on a computer-controlled automatic order-selection, collection and delivery system. Shoppers view only samples of products being sold or pictures of them; the actual merchandise is out of reach until the entire order has been selected and arrangements made for payment. Orders could be placed through use of selection buttons located adjacent to pictorial displays of items that are for sale.

Still another possibility is to design the customer-ordering system around colour-TV equipment and cassette-type magnetic-tape recorders. Store items carried in stock can be displayed on the TV screen and, if requested by the customer, representations of the containers and descriptions of contents can be shown on the screen. As the customer makes selections, the items are entered on a magnetic tape. At the end of the order-placing process, the cassette is placed into the automatic orderpicking system.

The report also saw need for a completely automated food procurement system capable of handling 100 to 300 or 400 different products. This "automated minimarket" would operate largely unattended and supply around-the-clock service.

The report stressed that to be successful, the automated mini-market must be a totally new design and not a facelift of the so-called vending machine. They would not be substitutes for supermarkets, but rather a complement to them and could be especially useful in apartment-type dwellings for the elderly and in areas where supermarkets cannot be operated profitably.

The fourth suggestion, the mobile automated market, is essentially an automated mini-market on wheels, increasing its accessibility to more people. The mobile market would include a 40-foot trailer, a computer-controlled order selection and billing system capable of serving several customers simultaneously, a product line of several hundred product types, and an ability to operate with one driver-operator and a helper.

Improving sound from 9.5 & 16mm projectors—3

A dynamic noise filter

Using a novel sequential switching system to control passive filter sections, this new dynamic noise filter design combines low distortion performance with simplicity of operation. While described here with filter characteristics tailored for improving poor movie sound tracks, it could easily be modified for processing signals from cassette tapes or old gramophone records.

by JAMIESON ROWE

This is the last of a series of three short articles discussing ways of obtaining improved reproduction from 16mm and 9.5mm optical sound tracks. You may recall that in the second article I described a simple sharp-cut low pass filter unit with adjustable turnover frequency, designed to allow you to find the best compromise between bandwidth and signal to noise ratio.

At the end of the description I noted that while a fixed filter of this type may be used to provide very satisfactory reproduction from the majority of sound tracks, there are some very poor tracks with which it still does not give acceptable results. This is because with a sound track having an exceptionally poor signal to noise ratio, the filter turnover frequency necessary to bring the noise down to an acceptable level is so low that the signal tends to become unintelligible.

Broadly speaking, the only way of effecting any real improvement with such very poor sound tracks is to supplement the fixed filter system with a dynamic filter: one whose filtering action is designed to automatically change, according to signal level, under the control of a "logic" circuit.

Such dynamic filters are not new, having first been developed in the days of noisy old 78rpm acetate gramophone records. They were designed to take advantage of the fact that if the human ear is presented with two competing sounds, it tends to ignore the weaker one even when the other sound may be only slightly stronger. In other words, we are mainly conscious of the noise present in a noisy signal during the inevitable "gaps" in the signal itself. When the signal itself is present, the noise tends to be less evident.

This means that to achieve a subjectively improved signal to noise ratio, the main thing is to filter the noise during any gaps in the wanted signal. The filter can be switched out of circuit when the signal itself is present, if this is necessary in order to prevent excessive muffling or degradation of the signal. And this is exactly what a dynamic noise filter is designed to do—let the signal through with as little disturbance as possible, while throttling back the noise whenever the signal is not present.

In a sense, dynamic filtering is a form of signal expansion, acting to increase the overall dynamic range. The aim is to increase the ratio between "loud" and "quiet" parts of the sound track, by making the "quiet" sections quieter.

Many techniques have been used in dynamic filters described over the years. However, by and large, these designs have tended to suffer from two main disadvantages. One is that the control elements used to change the action of the filter generally tend to introduce signal distortion, due to nonlinearity.

The other common disadvantage is operational complexity. Most dynamic filters described to date have had a bewildering number of controls and adjustments, and often these have been strongly interdependent. As a result many designs require the use of an oscilloscope and other instruments in order to set them up for correct operation. Even then operation can be rather tricky, and you almost need a pilot's licence to get good results!

When I came to the conclusion that some sort of dynamic filtering was going to be necessary in order to improve the sound quality from really poor films, I resolved to see if there wasn't a better way. Surely it would be possible to come up with a dynamic noise filter which didn't distort the signal significantly, wasn't full of critical adjustments, and would be easy to drive.

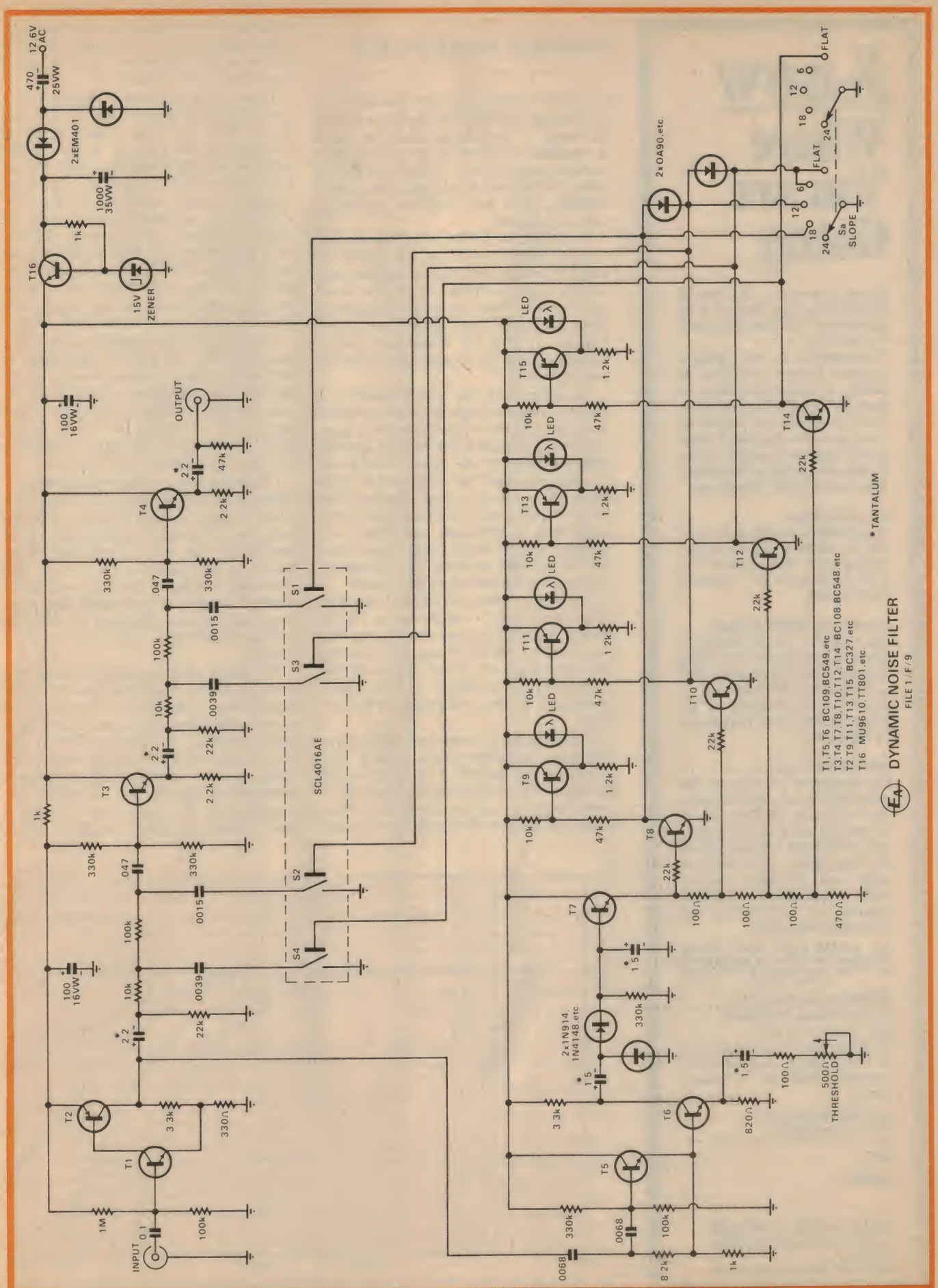
Well, to cut a long story mercifully short, we seem to have done it! By "we", I mean that it has been something of a team effort. Although the final circuit details of the filter to be described are my own work, the principle it is based on has been thrashed out as the result of a number of discussions with staff member Leo Simpson and Editor-in-Chief Neville Williams. So that they too deserve considerable credit.

Incidentally, Leo Simpson is planning to describe a two-channel modified version of the filter shortly, designed more specifically for improving the sound from stereo cassettes.

Essentially the new filter is based on the idea of digitally and sequentially switching a number of cascaded passive filter sections. This is in contrast with the more usual approach, which is to use continuous or "analog" control of a variable filter element. By adopting a digital approach, we avoid the problem of nonlinearity and also make circuit operation more straightforward and less critical.

To switch the passive filter sections in and out of circuit, I have used a CMOS

At left is the prototype dynamic noise filter, complete in its case. The full circuit diagram is shown opposite.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1000 35VW
1k
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100 16VW
OUTPUT
2.2
47k
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T4
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.047
0015
100k
10k
0039
22k
2.2
2.2k
T3
1k
INPUT
0.1
1M
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T2
3.3k
330Ω
T1
S1
S2
S3
S4
SCL4016AE
2xOA90.etc
FLAT
SLOPE
LED
T15
1.2k
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T11
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T3.T4.T7.T8.T10.T12.T14. BC108.BC548.etc
T2.T9.T11.T13.T15 BC327.etc
T16 MU9610.TT801.etc.
DYNAMIC NOISE FILTER
FILE 1/F/9

DYNAMIC NOISE FILTER

bilateral analog switch device, the SCL4016A. This has four identical switch elements in the one package, so that it is capable of switching up to four filter sections if necessary. The advantages of using CMOS switch elements are speed, reliability and the very low operating power required.

To understand how the filter works, you will need to refer to the circuit. T1 and T2 form an input buffer and preamp, serving mainly to make up for the insertion losses of the subsequent filter sections. The main signal path then follows through T3 and T4, which are emitter followers used for impedance matching and buffering.

As you have no doubt deduced already, the four controlled filter sections are of the simple series-R parallel-C type, with two positioned ahead of T3 and the other two after it. The values of the R and C elements used in each section have been chosen to give a progressive filter action as they are switched, and at the same time to minimise interaction—ensuring a suitably steep cutoff slope when all four sections are in circuit. The operation is fairly evident from the curves.

The earth return of each of the four filter capacitors is made via a CMOS switch element, as you can see, so that any or all of the filters may be switched in or out of circuit at will. The switching is performed by digital control signals, generated by the remainder of the circuit.

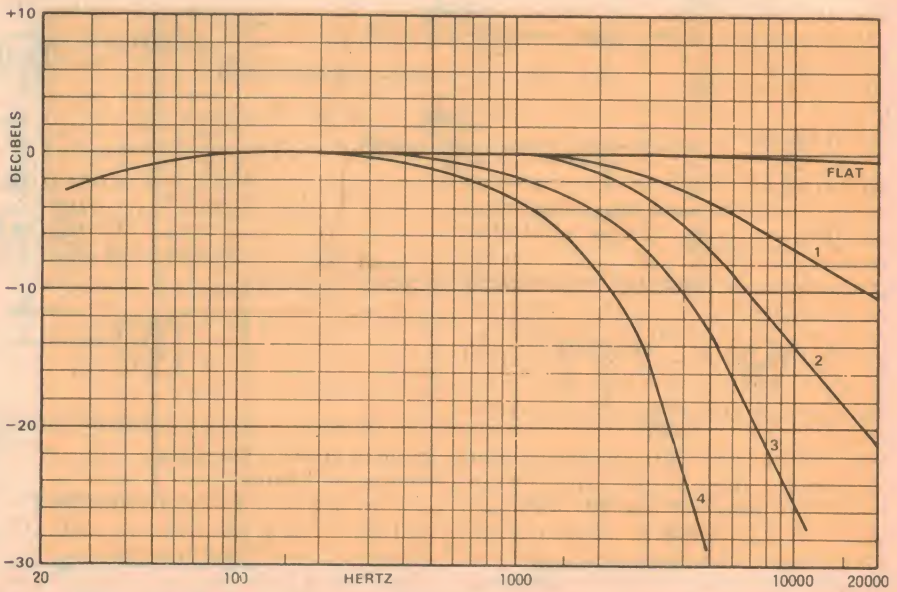
Transistor T5 is connected in an active high-pass filter stage whose input is connected to the output of the input signal preamp T1-T2. The active filter has a turnover frequency of about 800Hz, and a cutoff slope of around 15dB per octave. Its purpose is to ensure that the logic circuitry responds only to signal frequencies above the turnover frequency of the controlled filter sections.

There is no point in having the controlled filter sections switched out of circuit when only low frequency signal components are present, as this would not improve signal reproduction. In fact it would do just the opposite, as the low frequency signals would tend to become masked by accompanying bursts of higher frequency noise. Thus by deliberately preventing the logic circuitry from responding to low frequency signals, we ensure that the controlled filter sections are only switched out of the signal path when this is necessary and appropriate.

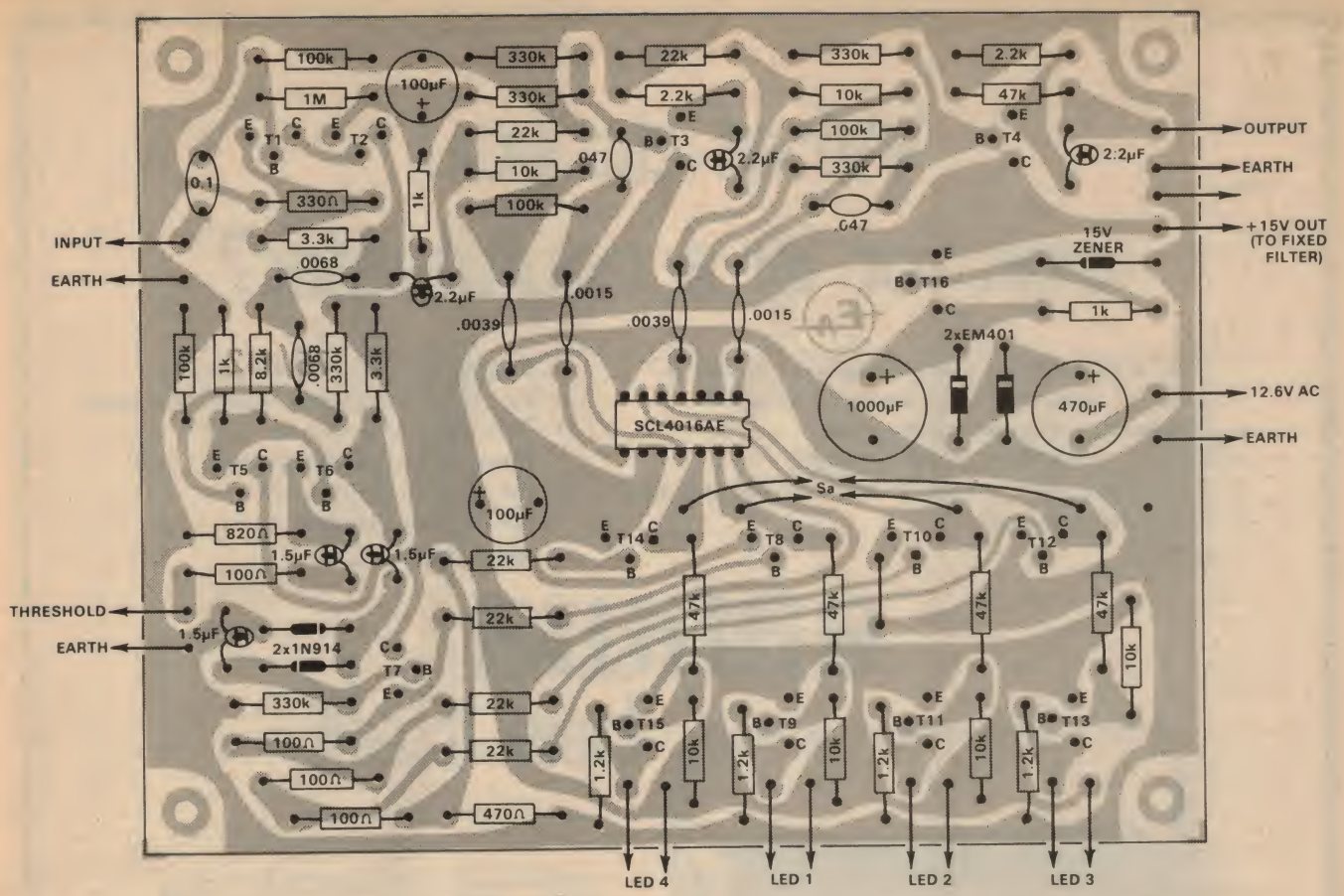
Following T5 is an amplifier stage using transistor T6. The gain of this stage is adjustable, being varied by means of the 500 ohm potentiometer in the emitter circuit. This allows adjustment of the input signal level at which the filter control logic operates, and the pot accordingly functions as a "threshold" control.

Following T6 is a voltage-doubling rectifier circuit, whose purpose is to derive a DC control voltage which is proportional to the peak-to-peak input signal amplitude. The source and load resistances of the rectifier circuit and the associated capacitor values have been selected to give a fast attack and relatively slow decay characteristic, as this seems to give the most acceptable results.

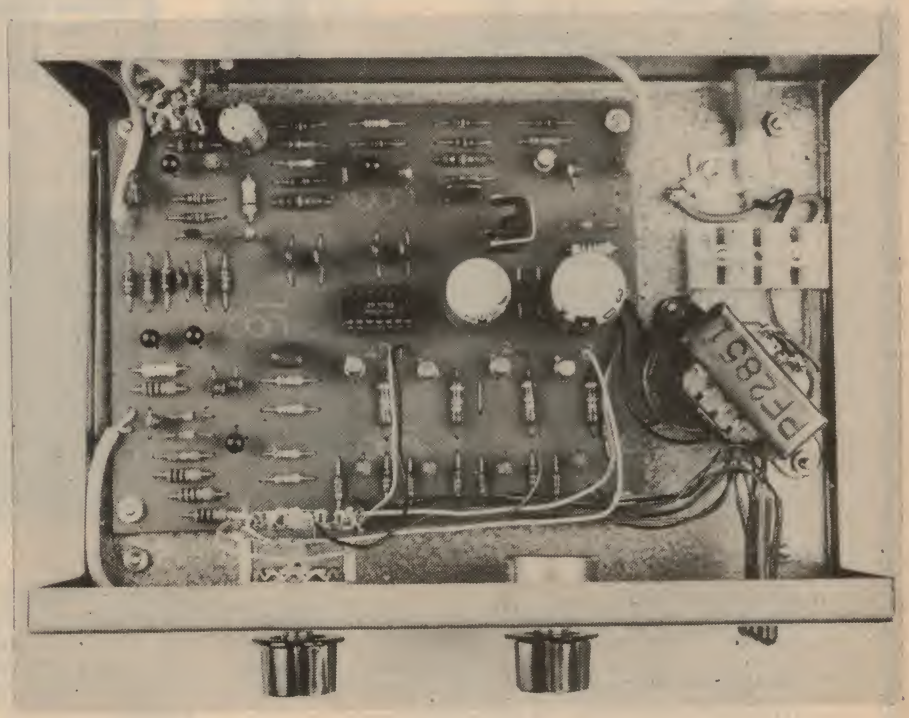
The attack timeconstant is around 5ms, which is short enough to allow the controlled filter sections to be switched out of circuit fast enough to prevent noticeable distortion of initial transients. The decay timeconstant is approximately 100ms, and this is long enough to prevent break-up of signals due to rapid filter chopping. At the same time, the decay time is short enough to produce only a



As you can see from these curves, the filter characteristic changes progressively as the filter sections are switched in and out.



Above is the wiring diagram for the PC board, with an inside view of the full dynamic filter at right.



slight noise "hangover" following the end of signal passages.

At the output of the rectifier is an emitter follower stage using transistor T7. This is used to maintain a high resistance level in the rectifier output circuit, and also to split the DC output signal of the rectifier into four proportional signals, derived from the tapped emitter load. the proportional signals are then used to drive four NPN transistor switches—T8, T10, T12 and T14, used to control the CMOS switch elements.

The idea of splitting the DC control signal into four proportional drive signals is to produce the desired sequential switching action of the controlled filter sections. As the DC output of the peak-detecting rectifier rises after the arrival of signal, the first transistor switch to be turned on will be T8. Then T10, followed by T12 and finally T14. When the signal ceases and the rectifier output falls, the four transistors will turn off in the reverse order.

As you can see, each transistor is used to operate one of the four CMOS switches controlling one of the signal filter sections. Hence the action of the circuit is to sequentially switch the filter sections out of circuit when an appropriate signal has been present for 5ms or more, and then sequentially switch them back in again if the signal is absent for more than 100ms.

The purpose of PNP transistors T9, T11, T13 and T15 is to operate four LED indicators, which are designed to give a clear visual indication of logic circuit operation. The LEDs have been used in place of the customary meter, because I believe they have two very important advantages. One is that they can respond far faster than a meter, so that they allow much more convenient and accurate setting of the logic threshold for correct operation. The other advantage is that the LEDs and their switching transistors are nowadays considerably cheaper than

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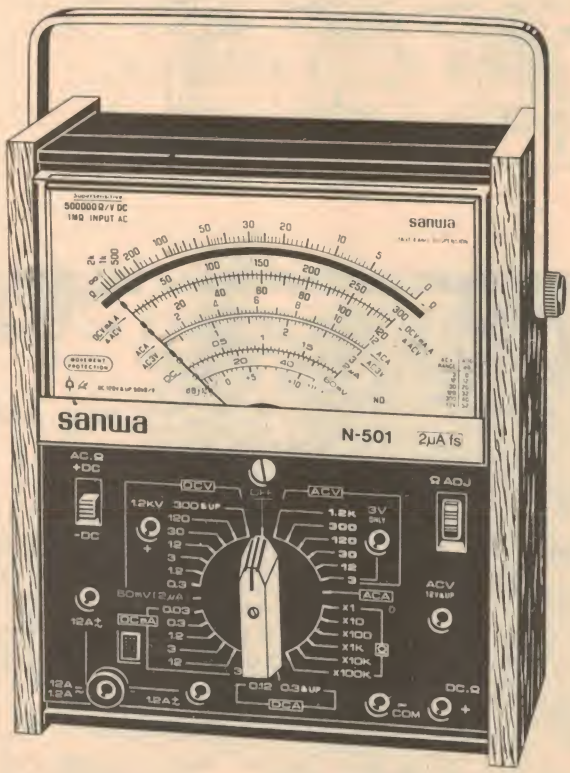

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a meter movement!

The LED switching circuitry may seem a little odd, as the LEDs are switched on and off by the PNP transistors acting as switches in shunt across them, rather than in series. This has been done deliberately, so that the LEDs directly reflect the status of the controlled filter sections. Under no-signal conditions with all filter sections in circuit the LEDs are all glowing, while they extinguish sequentially as the filter sections are switched out.

A further advantage of the shunt LED switching scheme is that the total supply current tends to remain fairly constant, as the current normally passing through each LED is merely diverted through its shunt switching transistor. This reduces switching current transients, and helps ensure that switching "spikes" are not injected into the audio signal passing through the filter.

Switch Sa has been provided to allow manual control of the number of filter sections active. It has five positions, and is arranged so that the fifth position disables all four sections. Using the switch you can therefore control exactly how many filter sections are under dynamic control at any time, to suit the degree of signal-to-noise improvement required. Signals which are already quite good may need only one filter section or none at all, while very poor signals may require all four.

As you can see from the circuit, there are only two manual controls for the entire dynamic filter unit—the threshold pot and the filter switch Sa. There are no internal presets whatever. From this you might expect that the unit is very easy to operate, and you would be right.

In fact operation is surprisingly straightforward. The filter is connected into the signal path between the projector preamp and the main amplifier, and preferably after the fixed filter unit if one is being used. Then turn Sa to a position other than "flat", so that one or more LEDs are glowing. Then with film being reproduced, it is simply a matter of adjusting the projector preamp output pot and the filter threshold control until the LEDs are "dancing merrily". They should be glowing during signal gaps, but extinguishing for wanted signals.

All that is necessary then is to find by trial and error the number of filter sections which give the best effect with the sound track concerned. Broadly speaking, the idea is to use as many sections as possible, without overdoing things so that the resulting modulation of the noise becomes obvious.

If you are using a fixed filter unit as well as the dynamic filter, it is worth trying different combinations of the settings of the two. Depending upon the sound track and its particular characteristics, the best results may well be found with a proportion of fixed filtering in conjunction with some dynamic filtering.

In other words, don't assume that the dynamic filter removes the need for fixed filtering. They are best regarded as complementary.

Incidentally, the input signal range covered by the threshold control with the values shown in the circuit is from 10 to 25mV peak to peak, which has been arranged to suit the preamp and fixed noise filter already described. If you use the unit with another preamp design you may find it too sensitive—in which case the LEDs will tend to extinguish on noise alone, even with the threshold pot turned fully anticlockwise.

If this is the case, you can easily reduce the sensitivity of the logic circuit by increasing the value of the fixed resistor in series with the pot. Although shown as 100 ohms, this resistor could be increased to 470 ohms if necessary.

Please note, however that due to the lack of DC bias on the CMOS switches, the maximum input signal level before distortion is approximately 120mV P-P.

As you can see, I have produced a printed circuit board which provides for almost all of the circuitry of the dynamic filter. The board measures 140 x 110 mm, and is coded 75/f12. You should find the board easy to wire up, using the wiring diagram and the photographs as a guide.

The only components not mounted on the PC board are the power transformer, the rotary switch Sa, the threshold pot, the four LEDs, and the input and output connectors. The transformer mounts in the case alongside the PC board, in the usual manner, while the connectors are mounted on the rear of the case. The remaining items are mounted on the front panel.

Rather than use expensive bezel-mounted LEDs, I elected to use the normal low-cost type, cementing them into holes in the panel using epoxy adhesive.

The case used for the prototype filter unit is one of the small "amplifier" utility type, made by Wardrope and Carroll Fabrications Pty. Ltd. It measures 200 x 153 x 78 mm, and is finished in light brown hammertone lacquer. I have produced a negative of the front panel shown in the pictures, and copying negatives will be available via the Information Service. The prototype front panel was made using 3M "Scotchcal" photosensitive material.

Note that the DC output of the filter power supply regulator is made available at the edge of the PC board, so that the supply may be used to power the 741 op amp in the fixed filter described last month, if you wish. Alternatively the dynamic filter itself could be powered from your main amplifier, if the capability is there to provide 15V at about 90mA. In this case the power supply shown in the circuit may be left out, and the supply fed into the board at the 15V pad.

Well, that just about finishes the story. I hope you have found this short series of articles on improving the reproduction from optical sound tracks of interest, and that the circuits presented will be of help to you in achieving the best results from your 16 mm and 9.5 mm equipment.

DYNAMIC NOISE FILTER PARTS LIST

1 Case, 200 x 153 x 78mm
1 Transformer, 240V to 12.6V at 150mA
1 PC board, 140 x 110mm, code 75/f12
1 Single section 2 pole 5 position rotary switch
2 Audio connectors as required
1 500 ohm linear pot
2 Control knobs as required

SEMICONDUCTORS
3 BC109, BC549 or similar low noise NPN
7 BC108, BC548 or similar NPN
5 BC327, BC558 or similar PNP
1 MU9610, TT801 or similar NPN
1 15V/400mW zener, BZX79/C15 or
2 OA90, OA91 or similar diodes
2 1N914, 1N4148 or similar diodes
2 EM401, BY126/50 or similar diodes
4 Low cost LEDs (red)
1 SCL4016A or similar CMOS quad bilateral switch IC

RESISTORS (All ½W 5%)
4 x 100ohms, 1 x 330ohms, 1 x 470ohms, 1 x 820ohms, 3 x 1k, 4 x 1.2k, 2 x 2.2k, 2 x 3.3k, 1 x 8.2k, 6 x 10k, 6 x 22k, 5 x 47k, 4 x 100k, 6 x 330k, 1 x 1M

CAPACITORS
2 470pF polystyrene
2 6800pF LV polycarbonate
2 .01uF LV polycarbonate
2 .047uF LV polycarbonate
1 0.1uF LV polycarbonate
2 1.5uF 25VW tantalum
2 2.2uF 25VW tantalum
2 100uF 16VW electrolytic
1 470uF 25VW electrolytic
1 1000uF 35VW electrolytic

MISCELLANEOUS
Mains cord and plug, grommet for cord entry, mains cord clamp, length of B-B strip for mains cord termination. Screws, nuts, connecting wire, solder, etc.

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings may also be used in some cases, providing the ratings are not exceeded.

Control your tape recorder with this

Voice-operated Relay

This is a multi-purpose circuit. It can be used as a voice-operated relay to control a tape recorder, or as a VOX circuit for a transmitter. It can be used with any low impedance or high impedance microphone or a high level source such as a tuner.

by LEO SIMPSON

Quite a few uses can be imagined for this circuit. An obvious use is as a VOX control in a transmitter. It could also be used to control a tape recorder when the material being recorded is of short and spasmodic nature. Another possible use is as a basis for a muting circuit or indeed any sound–controlled function requiring short attack time and slow decay.

The circuit consists of three parts, a microphone preamplifier, a Schmitt trigger and a relay driver. We will start at the left of the circuit and begin with the microphone preamplifier. This is identical to the preamplifiers used in our 8-input mixer of February, March and April 1975 (File 1/MX/10, 11, 12). It is a direct-coupled pair employing two low-noise silicon NPN transistors. Gain is adjustable to suit 600 ohm or 50k dynamic microphones.

There are two feedback loops in the microphone preamplifier. That from the emitter of the second transistor to the base of the first is DC only and sets the DC conditions in the preamp. The second feedback loop is from the collector of the second transistor to the emitter of the first. This is predominantly AC feedback and sets the gain of the preamplifier.

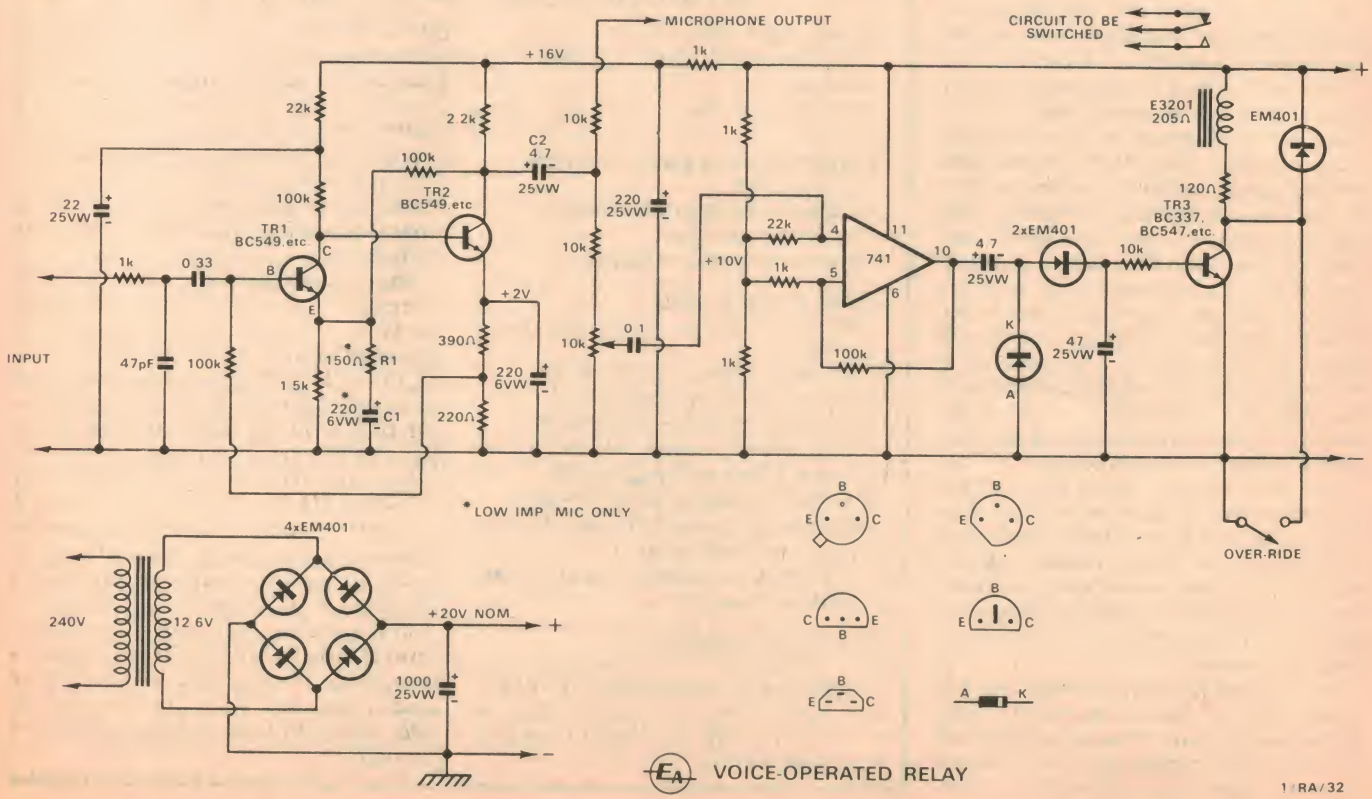
With R1 and C1 included the gain is high enough to suit 600 ohm microphones. In fact it may be too high for some and may have to be reduced. To halve the gain, simply double R1. With R1 and C1 omitted, the gain is sufficient for normal 50k dynamic microphones.

Output signal from the preamplifier is coupled via C2 to a 10k resistor and 10k trimpot which feeds the op amp Schmitt trigger. The microphone output signal is also available via an additional 10k isolating resistor, to drive a high level input on a tape recorder or whatever.

The Schmitt trigger configuration may seem a little unusual at first sight. A voltage divider consisting of two 1k resistors sets the bias for the inverting and non-inverting inputs of the 741 operational amplifier and thus allows it to function with a single rather than the usual balanced supply rails.

Signals from the trimpot are fed to the inverting input. Notice that there is no negative feedback to the inverting input. Instead, there is a positive feedback to the non-inverting input. This has the effect of setting the hysteresis of the Schmitt trigger. For small signals to the inverting input there is no AC output and

This circuit suits 600 ohm or 50k microphones or may be operated from signals of more than 100mV RMS by omitting the preamp.

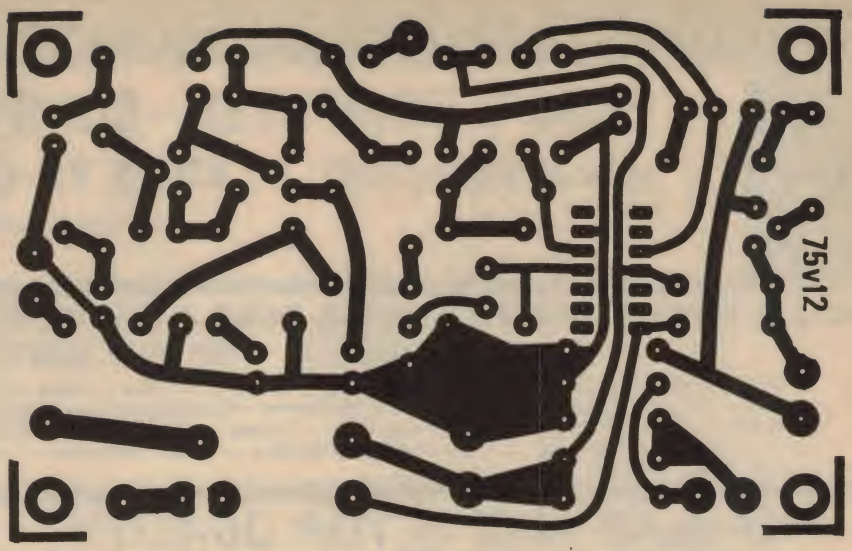


PARTS LIST

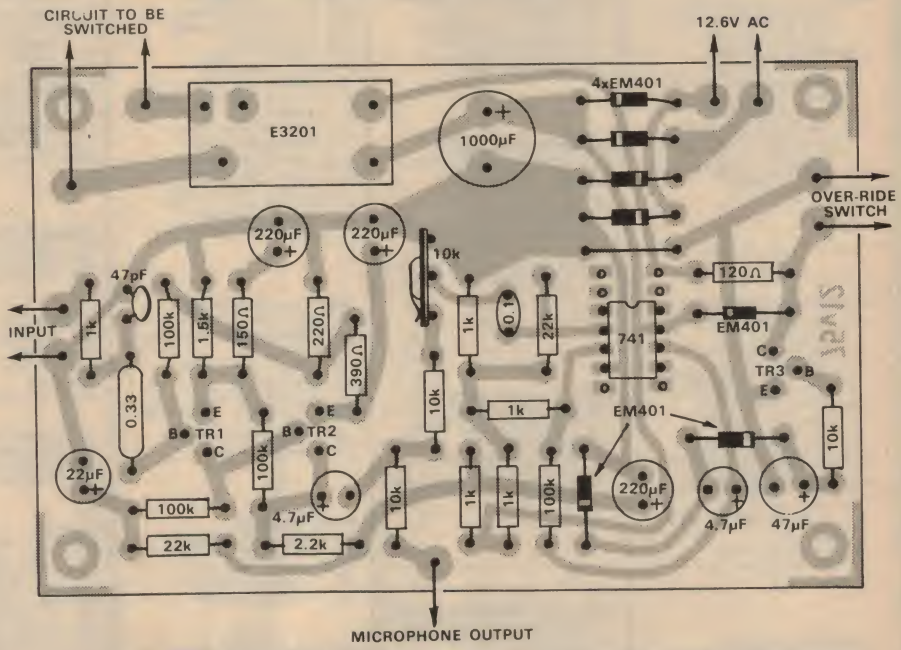
1 PC board, 110 x 70mm, code 75v12
1 miniature power transformer with 12.6VAC secondary, Ferguson PF2851, A&R 6474 or similar
1 SPST switch
2 BC549 NPN silicon transistors
1 BC547, BC337, NPN silicon transistor
1 741 operational amplifier
7 EM401 silicon diodes
1 12V SPDT relay E3201, MD265 or similar
9 PC stakes

CAPACITORS
(all PC end-mounting types)
1 x 1000uF/25VW electrolytic
1 x 220uF/25VW electrolytic
2 x 220uF/6VW electrolytic
1 x 47uF/25VW electrolytic
1 x 22uF/25VW electrolytic
2 x 4.7uF/25VW electrolytic
1 x 0.33uF metallised polyester
1 x 0.1uF metallised polyester
1 x 47uF ceramic.

RESISTORS
(all ¼ or ½W, 5% tolerance)
4 x 100k, 2 x 22k, 3 x 10k, 1 x 2.2k, 1 x 1.5k, 5 x 1k, 1 x 390, 1 x 220, 1 x 150, 1 x 120 ohms.
1 x 10k trimpot
NOTE: Components with higher ratings may be used provided they are physically compatible. Lower rated components may also be used in some cases, provided their ratings are not exceeded.



Here is an actual size reproduction of the PC board.



Layout of components on PC board. Use PC stakes or pins to make connections.

in fact the output terminal is at almost the positive rail potential.

When the signal to the inverting input rises above about 170 millivolts peak-to-peak (which is 60mV RMS for a sine-wave) the output suddenly jumps to the limiting condition which is a square wave at the input frequency with amplitude just a little less than the full supply voltage, ie, about 18 volts peak-to-peak.

So the op amp suddenly changes from a zero gain condition to the limiting condition. This contributes to the fast attack time.

An interesting sidelight to the Schmitt trigger is that it does not revert to the zero gain condition until the signal to the inverting input drops below 20mV RMS (for a sine wave). Output from the Schmitt trigger is fed to a half-wave voltage doubler rectifier which charges a 47uF capacitor. This capacitor (when charged) provides base bias to the relay driver transistor to enable it to energise the relay.

So the overall mode of operation is as follows: Input signals to the microphone preamplifier are amplified and fed to the threshold trimpot. When the selected threshold is exceeded, the output of the Schmitt trigger suddenly rises to 18 volts peak to peak which is rectified and fed to the 47uF capacitor to turn the relay driver on and thereby energise the motor circuit of the tape recorder or whatever device is being controlled.

Attack time of the circuit is inherently limited by the closing time of the relay and this is typically about 10 milliseconds. Delay time after the cessation of input signal is set by the size of the 47uF capacitor to about 3 seconds, which should be ample for most purposes.

Since the relay is a 12V unit, it is fed via a 120 ohm resistor to obtain the correct voltage across it. A diode across the series combination protects the relay driver transistor against inductive kick-back from the relay.

A full-wave bridge rectifier and 1000uF filter capacitor provide the DC rail requirements from any transformer having a 12 to 13VAC secondary winding.

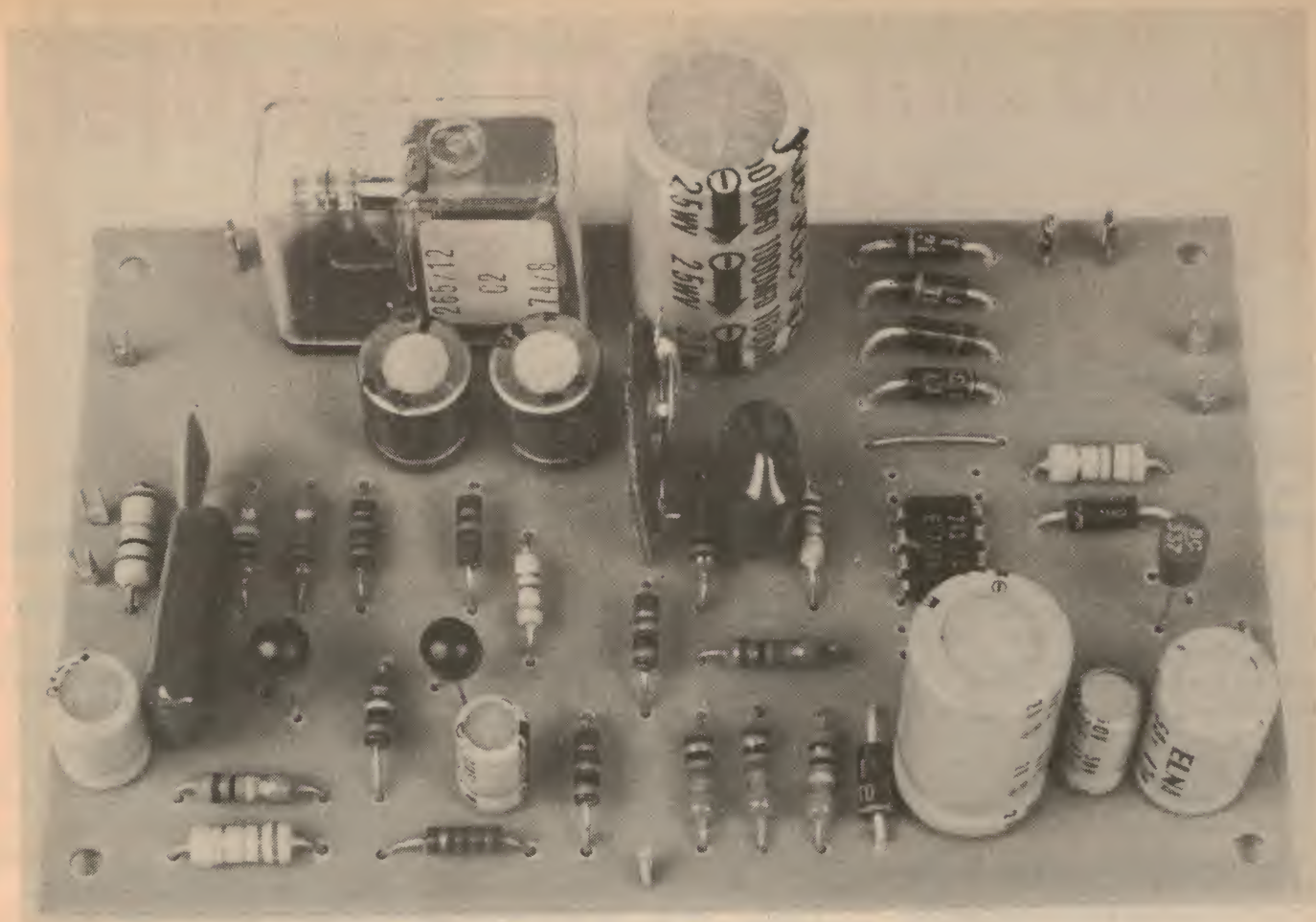
All the components, minus the transformer, are accommodated on a PC board measuring 110 x 70mm with type code 75v12.

The copper pattern of the board is compatible with the three commonly available 741 op amp packages. This is by virtue of the fact that pins 1, 2, 7, 8, 12, 13 and 14 of the 14-lead package have no internal connection while the remaining pins have the same orientation as those of the smaller packages.

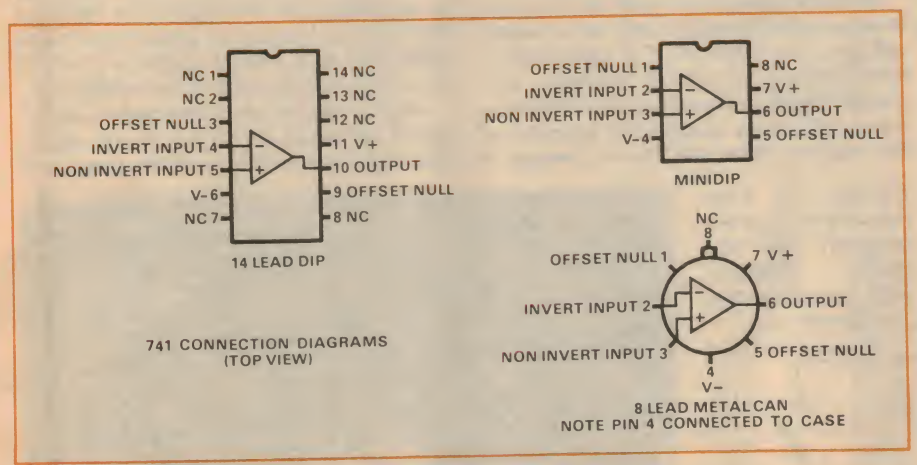
Similarly, while we have specified only BC series TO-92 transistors, the board is compatible with all currently available transistors. Check the transistors you have against the appropriate base diagram on the circuit.

In the interests of uniformity we have specified EM401 silicon diodes throughout. If you have some small signal diodes on hand, they may be pressed into service to rectify the output of the Schmitt trigger.

If you substitute a different relay for



Larger than life size photo of the assembled PC board.



Three different packages of the 741 op amp may be used on the board.

the types we have specified and intend it to switch a 240VAC circuit, make sure it has appropriate contact ratings. The relay we used is soldered directly to the PC board, no socket being used.

If you intend the circuit to be controlled by signals with an amplitude of 100mV or more, the preamplifier stages may be omitted. Just omit all the components to the left of C2. Then substitute a wire link for the 10k resistor between C2 and the trimpot. The input signal is then coupled in via C2. The source impedance of the signal to drive C2 in this way must be less than 5k. The "monitor" output available on many cassette and tape decks is quite suitable for the purpose.

The trimpot may be replaced with a conventional potentiometer as a panel-mounting control, if you so desire.

If the microphone input facility is required, the PC board should be well-shielded or enclosed in a metal box to keep hum and noise to an absolute minimum. The circuit should be grounded only via the microphone input earth return.

Build our Water Warbler for healthy pot plants

Are you unable to tell when your favourite pot-plant requires water? Do you err on the safe(?) side, water every day, and then find that all your plants have died of root-rot? Or do you only water when the soil has a constituency approaching that of concrete? Now, all your troubles are over. Our new Water Warbler will tell immediately if your plants need water.

by DAVID EDWARDS

The Water Warbler is a small box, fitted with two long prods. When these prods are inserted into soil, a sound is emitted, the pitch of which corresponds to the amount of water present in the soil. If the soil is dry, a slow "put-put" is produced, while saturated soil will produce a characteristic high pitched "squeal". Soil that is adequately moist will produce a more pleasant tone, midway between these two extremes.

With a little practice, you will be able to recognise the various tones, and accurately estimate the exact amounts of water required by each plant. Guesswork will be eliminated, and your plants will thrive in soil which is at the correct moisture level.

The principle behind this useful little device is incredibly simple. The electrical resistance between the two test prods, which depends on the soil moisture content, is used to control an oscillator, which in turn drives a small speaker. Battery powered, the Water Warbler fits comfortably in the hand, and will no doubt prove a boon to the home gardener.

Referring now to the diagram, we can see that the sole active device is an integrated circuit, the ubiquitous 555 type timer. This is connected up as a multivibrator, and drives the small speaker direct. The 0.047uF timing capacitor is charged via the test prods, the 1k protective resistor, and the 10k resistor.

When the voltage on pin 6 reaches two-thirds of the supply voltage, an internal flip-flop is reset, and pin 7 is grounded. This discharges the capacitor through the 10k resistor. When the voltage on pin 2 reaches one-third of the supply voltage, the flip-flop is set again, and the cycle starts over again.

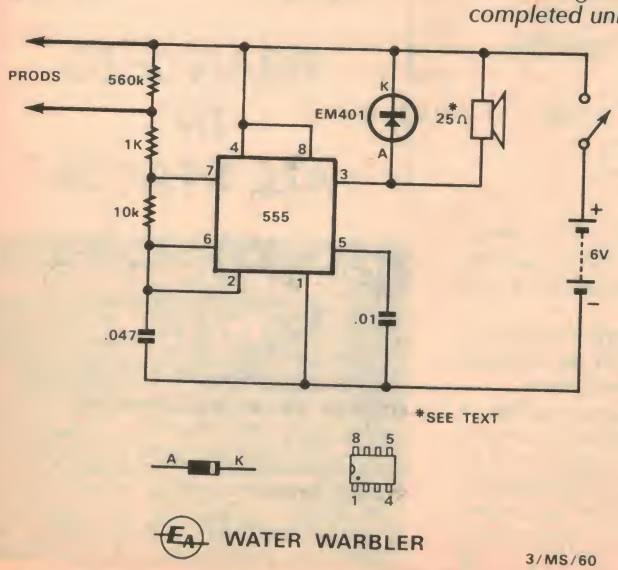
Since the charge rate and the threshold levels are both proportional to the supply voltage, the frequency of operation is independent of supply voltage. This means that the only effect of battery rundown will be to change the intensity of the output. There will be no change in the frequency, so that the Water Warbler will stay "calibrated".

The 1k resistor limits the current when the prods are short–circuited, and also sets the maximum rate of oscillation. The 560k resistor sets the minimum rate, and has been chosen so that a slow "put-put" is produced. This serves as an indication that the power has been turned on, and should prevent accidental discharge of the battery.

Sound output is produced by a miniature loudspeaker, of the type that is normally fitted to small portable radios. Since the 555 timer can only supply currents of the order of 200mA, some care is necessary in the choice of speaker impedance. We used a 25 ohm type, and although this does represent a slight overload, we found it to be satisfactory.

Higher impedance speakers can be used without any circuit changes, although the sound output produced

Below is the complete circuit diagram for the Water Warbler, while at right is the completed unit.



may not be as great. Lower impedance speakers can be used with a series resistor, to increase to load on the 555 to an acceptable figure. Thus, if a 15 ohm speaker was used, it would be necessary to insert a 10 or 12 ohm resistor in series.

The EM401 diode connected across the speaker is to prevent damage to the 555 by any inductive spikes generated by the speaker.

Construction of the Water Warbler should present no difficulties. We used a readily available plastic box as the case. Drill a neat pattern of holes in the front, to act as a baffle for the speaker. This can be held in place using small screws, nuts and washers, placed around the circumference.

We made our prods from two steel skewers, which we soldered into the ends of brass spacers. This enabled them to be simply screwed to the case from the inside. Connections to the prods were made using solder lugs. The on-off switch can be held in place by self-tapping screws.

PARTS LIST

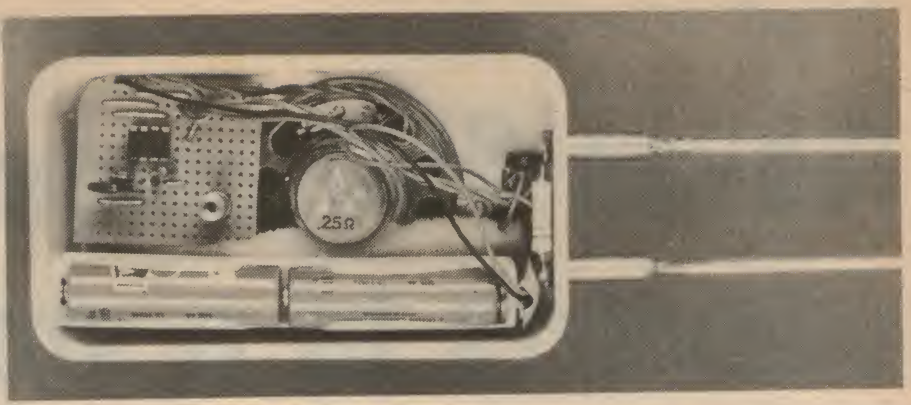
1 miniature speaker, 25 ohms.
1 switch, single pole single throw.
1 555 timer.
1 EM401 diode
1 1k, 1 10k, 1 560k resistors
1 0.01uF, 1 0.047uF plastic capacitors
1 case.
4 penlight cells, holder and connection clip.
1 piece 2.54mm Veroboard.
2 prods, 150mm long.

MISCELLANEOUS
Hookup wire, solder, solder lugs, machine screws, nuts, washers, threaded spacers, foam rubber.

Note: resistor wattage ratings and capacitor voltage ratings are those used in our prototype. Components with higher ratings may generally be used provided they are physically compatible. Components with lower ratings may be used in some cases, providing ratings are not exceeded.

We assembled the electronics on a small piece of 2.54mm spacing Veroboard, as this suits the pin spacing of the IC. As the circuit is very simple, we have not provided details of the actual placing of the components. An idea of our layout can be gained from the photographs. Connections to the various elements not on the Veroboard can be made using twisted pairs of hook-up wire.

The 560k resistor is most conveniently fitted directly across the solder lugs used to connect to the prods. The Veroboard is supported on a spacer fitted to the screw which mounts the speaker. A short piece of threaded shaft is screwed into the spacer, the Veroboard fitted, and a second screwed spacer fitted. The length of this spacer is adjusted so that it forms a support for the back panel, which is held on with a single screw.



Interior view of the prototype showing the disposition of the various components.

The type of battery holder we used can be seen in the photographs. This was chosen because it was a press fit into the case, and only required a small piece of foam rubber to prevent movement.

Suitable labels can be applied to the front of the case, using stick-on lettering. When finished, this can be protected by spraying with a clear lacquer. Construction of the Water Warbler is now complete.

Use of the device is extremely easy. Simply approach the required pot (stealthily if the plant is sensitive!), switch on, and thrust the prods deep into the soil surrounding the roots. If a high pitched squeal is emitted, then the soil is saturated, and water is definitely not needed.

On the other hand, if the pitch of the sound does not rise on contact with the soil, then your plant is direly in need of water, which should be supplied forthwith. After the water has had time to soak in, test again. If a mellow note is obtained, all is well, and your plant will be sure to thrive.

To conclude, a note on safety. The Water Warbler is capable of emitting extremely high pitched sounds, which may affect people with sensitive hearing, as well as dogs and other animals. If you are unfortunate enough to be attacked by a frenzied beast, we suggest that you wield the Water Warbler in the manner of a rapier!

For split second timing or as an aid to counting

Novus 650 calculator converts to a stopwatch

With a little care and a few CMOS integrated circuits, it is possible to convert a low cost four-function digital calculator so that it can be used as a precision stopwatch. This article explains how to convert a "Novus 650".

by N. H. CAMPBELL*

Because the Novus 650 calculator chip is directly compatible with National Semiconductor's 74C line of CMOS, a crystal controlled CMOS oscillator will convert this calculator to a stopwatch. At a 100Hz rate it will time to 9999.99 seconds, a little over two and a half hours, and at the 1Hz rate it will run for more than eleven days. Over a period of forty-eight hours, running at the 1Hz rate against the time signal from VNG, it was impossible to tell whether the prototype was gaining or losing.

In stopwatch mode, the calculator keeps on adding ones to the total at a preset rate. However, because full use of the keyboard is retained, it can count in manually entered numbers other than one. Counting by nines at a 1Hz rate challenges the children learning tables. Counting by 1.5 at a 1Hz rate shows the cents running away on an STD call from Sydney to Hobart, Counting by twos or threes at the 100Hz rate gives digit changes by halves or thirds of seconds at a speed that can be read while the watch is running.

The Novus 650 is a six-digit four-function calculator. A decimal point fixed at two places is wired into the circuit. As a calculator it is unsophisticated, but it has advantages for this project. It is cheap, its method of calculation lends itself to the repetitive addition of a constant, and its uncluttered circuitry simplifies modification.

The calculator components could be bought separately, but this is hardly worthwhile when the components with a case, keyboard and printed circuit are so cheap.

To quote from National's application note, the MM5736 calculator "has three inputs (K1, K2, K3) that are designed to be driven by a keyboard matrix and two sets of outputs: 6 digit outputs and 7 segment outputs . . . These outputs are designed to drive a LED readout in a 'digit' multiplexed manner by strobing the LED characters with the digit outputs. The digit outputs cannot drive the LED display directly and must be buffered with a DM75492 digit driver. The segment outputs will drive low current LED displays directly".

Numbers are entered, and arithmetic and clear functions initiated, by connecting digit outputs to K inputs as indicated in Table 1.

TABLE 1

Digit Output	K1 Pin 4	K2 Pin 5	K3 Pin 3
D1 (Pin 2)	0		CLR
D2 (Pin 17)	1	6	
D3 (Pin 16)	2	7	–
D4 (Pin 1)	3	8	+
D5 (Pin 15)	4	9	×
D6 (Pin 14)	5		+

(Blanks are illegal connections)

The calculator chip provides switch debounce by requiring that, between successive connections of digit outputs to K inputs, a time lapse occurs during which none of the digit outputs are connected to the K inputs. The length of this debounce interval makes the calculator relatively slow. In order to use the 100Hz

A general view of the completed control unit together with the Novus 650 calculator. Controls are (anticlockwise from bottom left) clear and reset (white); stop/start (black); select 1 or 100Hz; and select decimal point. The socket at top right is for recharging the battery.

*19 Brushy Creek Rd, Lenah Valley, Tasmania 7008.

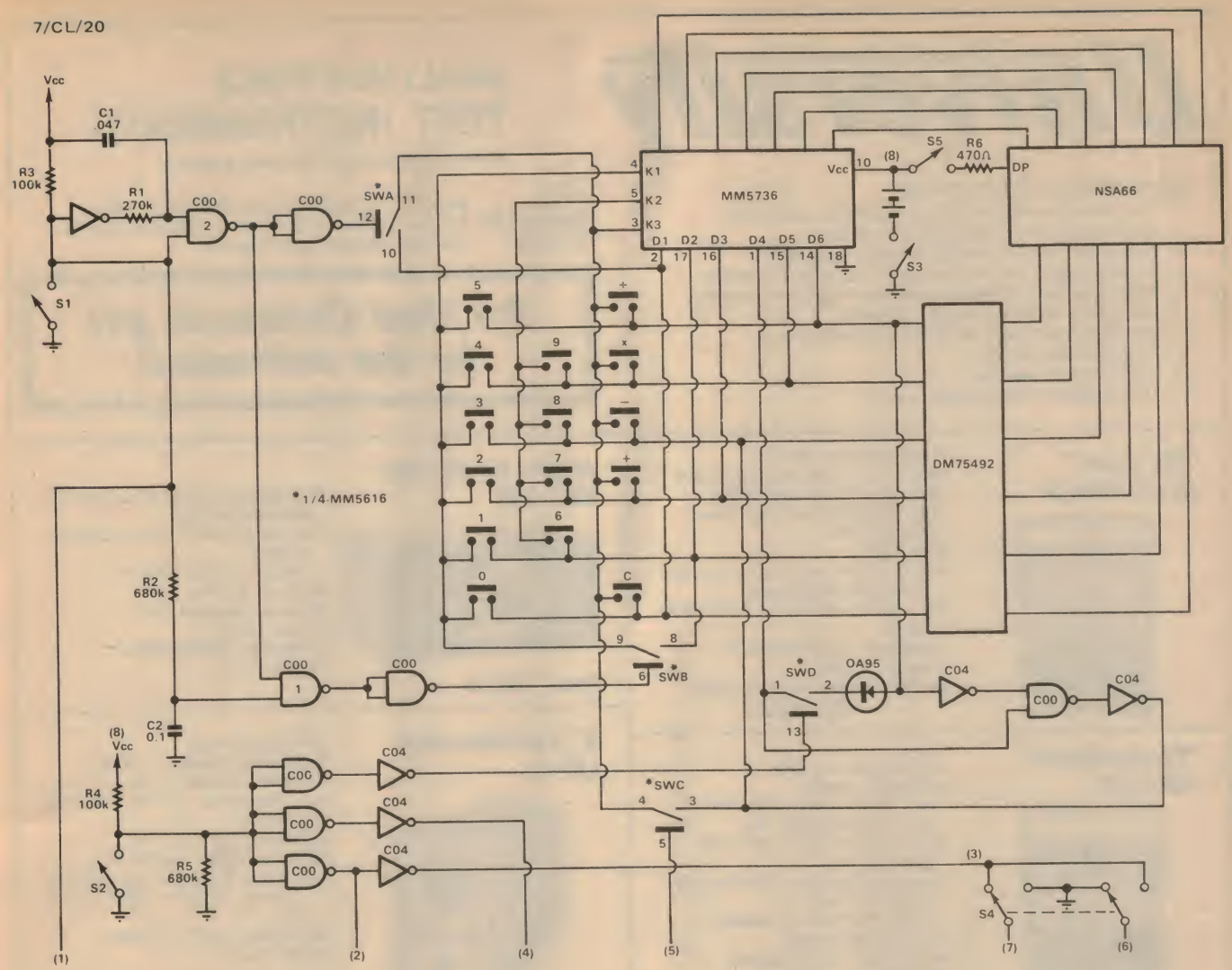


Fig. 1: The original calculator circuit together with the interfacing and control circuitry.

timing rate, this timeout must be speeded up, as will be shown.

The calculator as purchased makes the connections in Table 1 through the keyboard. The stopwatch connection makes the appropriate connections independently of the keyboard in a programmed and timed sequence.

The timer consists of three elements —the reset circuitry, the switching circuitry to control the timer and isolate it from the calculator, and the oscillator circuitry.

The reset circuitry clears the calculator, enters a "1" to initiate counting, and resets the divider network in the oscillator circuit to "0". The "clear and enter 1" circuit is at the top left of Fig. 1.

When the "Reset" switch, S1, is opened, both inputs to the NAND gate COO(1) go high, and consequently the control of SWA goes high and connects D1 to K3, thus clearing the calculator. After a delay of about 30ms caused by R1 and C1, one input to the gate goes low, the switch control goes low, and SWA is disconnected. At the same time, the input to COO(2) controlled by COO(1) goes high and shortly afterwards the second input to this gate, after the delay caused by R2 and C2, also goes high. The consequent high on the control of SWB connects D2 and K1 to enter a "1" in the display. When S1 is closed the control inputs of both switches are held low and SW A and B remain open.

TABLE 2

CONTROL	Switch On	First Pulse (Enter)	Second Pulse +	Third Pulse +
DISPLAY	1 (1st interval)	1 (2nd interval)	2 (3rd interval)	3

It would be more elegant but less accurate to have the display cleared when the timer was switched on, and to have the initial "1" entered by the first pulse from the oscillator. But to enter a "1", debounce the calculator, and then begin adding would take some 40ms. This means that, at the 100Hz rate, four hundredths of a second would elapse before counting began. With a "1" entered by the reset circuit, counting is completely accurate. The sequence is shown in Table 2.

The display shows "1" for both the first and second time intervals, instead of showing "0" and then "1". In practice this does not matter. At the 100Hz rate you cannot see what is happening, and you would not use the 1Hz rate if you were concerned about when the first second had elapsed.

The timing and isolating circuitry (lower part of Fig. 1) uses SWC to connect D4 to K3 on each pulse from the oscillator, thus effecting a succession of additions, and SWD to enable the speed-up of the bounce delay in the timing mode, and to disable it in the calculator mode. This circuit is controlled by the "Start/Stop" switch, S2, through its gate/inverter chain. S2 also controls the switches in the oscillator circuit.

To quote again from National's application note, feeding digit 6 output to digit 4 "fools some internal logic" in

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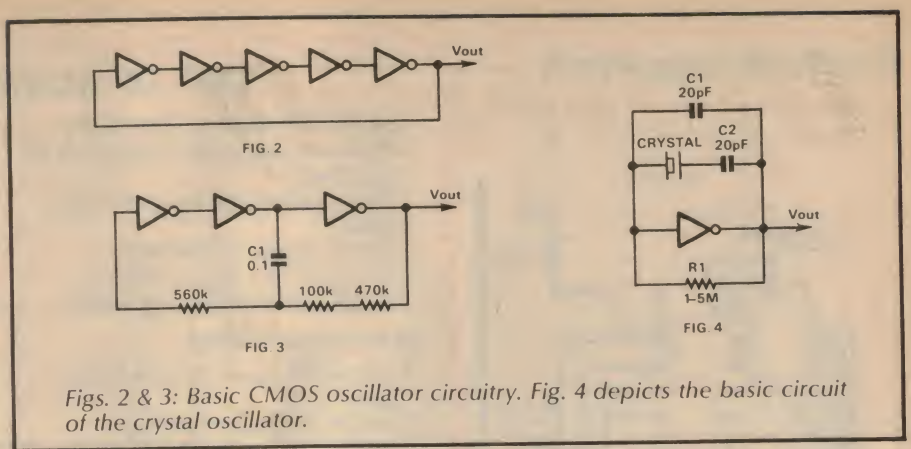
Electronic Stopwatch

the calculator chip so that the calculator can handle inputs at the rate of 120-300Hz, depending on the particular chip in use. However, this results in a double pulse on digit 4 which must be gated back to a single pulse at the normal digit 4 time. This requires, in addition to the switch, a diode to keep digit 4 off digit 6, and a gating circuit to keep the extra pulse off the display and keyboard.

The CMOS oscillator circuitry is based on the fact that an odd number of CMOS inverters, tied to one another in a ring, as in Fig. 2, will always oscillate. The effect is that of a series of "1s" chasing each other round the loop. This circuit alone, dependent as it is on voltage and temperature, is fast but unstable. Three inverters will oscillate at something more than 9MHz. Stability can be increased, and frequency controlled, by the addition of resistors and a capacitor, as in Fig. 3.

The circuit in Fig. 3 is fairly stable for low resolution and short runs. With the values shown, it will serve for a one-tenth-of-a-second timer for periods up to 100 seconds. Over this period, the instability is less than the resolution of the timer. Substitution of a .01uF capacitor will increase the frequency to 100Hz, but will also increase the instability. Even so, experimenters may prefer to use this oscillator as a first step, just to see the stopwatch running. With average components, the 100k preset pot will give adequate frequency adjustment.

It is advisable to build this oscillator on a separate piece of veroboard, because the chances are that its limitations will soon lead to the need to replace it by the crystal controlled clock. If you decide to use this simple oscillator, connect the inverter package to Vcc and Gnd and connect the oscillator output to the control of SWC by a double throw switch which holds SWC low in the "timer off" mode.



Figs. 2 & 3: Basic CMOS oscillator circuitry. Fig. 4 depicts the basic circuit of the crystal oscillator.

The basic circuit of the crystal oscillator is shown in Fig. 4. R1 provides a DC path to ensure that the oscillator will start, and C2 can be varied to give a fine adjustment of frequency. This oscillator is relatively insensitive to voltage variations.

A problem arises with crystals with a frequency below 4MHz, because the inverter chain may allow the crystal to oscillate at its third harmonic. Propagation delay can be introduced by increasing the number of inverters in the chain, and introducing R7 and C3, as in Fig. 5. Since the frequency of the inverter chain is directly proportional to supply voltage, the problem is to ensure that the chain can keep up with the crystal over the range of voltages provided by a battery as it discharges, and also that at maximum voltage it is not fast enough to allow the crystal to oscillate at its third harmonic. The values shown in the circuit result from a good deal of trial and error. Even then, a zener diode regulator is needed to hold the supply voltage of the crystal/inverter network below 6 volts.

The crystal is a D type 1.6384MHz. The output from the oscillator goes to a MM5620 binary divider (divide-by-2^{14}) so that a single CMOS package gives a reduction to 100Hz. The 1Hz output is obtained by passing the 5620 output into two successive MM5617 divide-by-ten counter/dividers. Some constructors may want to use the neglected 10Hz output.

A second MM5616 package is used for switching the oscillator outputs. SWE cuts off signals from the 5620 so that the dividers can be zeroed. The remaining three switches select the 1Hz or the 100Hz output to the calculator.

The calculator chip is designed to operate over the 6.5-9.5 volt range, and the CMOS can use the same supply. The unit can be run from the calculator battery or an AC adaptor. Novus sell a rechargeable conversion kit for one of their calculators. A cheap general purpose rechargeable battery pack can be made by fitting the cells from this kit into a Holden ignition contact box as shown in the photograph.

CMOS should be handled carefully. Leave chips in protective foil until they are to be used, work on non-conductive surfaces, and avoid touching pins with the fingers. In spite of the need for care, if the circuit fails to operate, it is more likely to be because of a mistake than because of chip failure. The CMOS family is really very friendly.

The ICs can be soldered directly onto

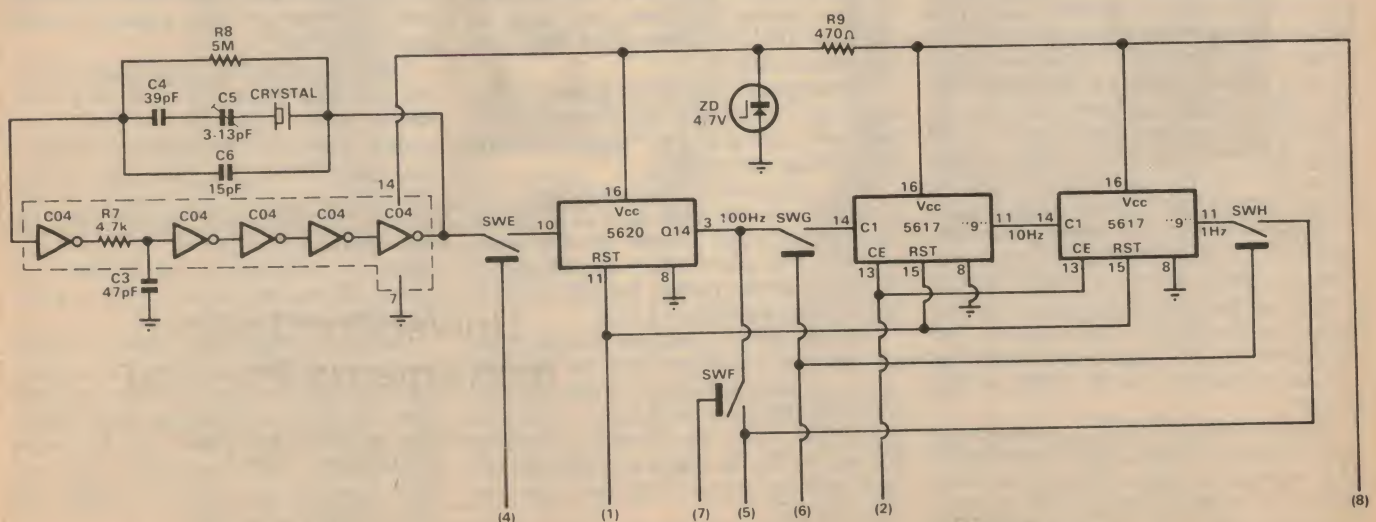


Fig. 5: The clock circuit consists of a 1.6384MHz crystal oscillator, three divider ICs, and a switching IC.

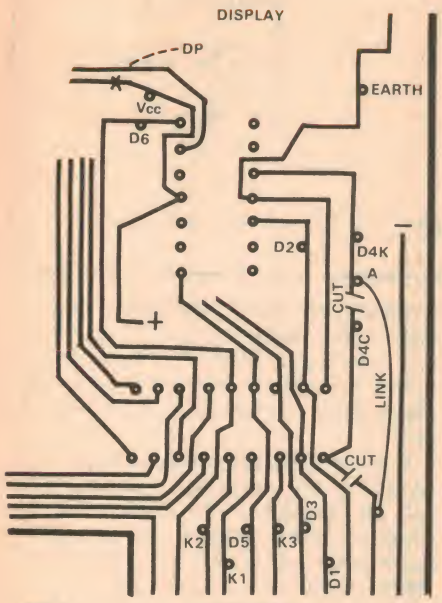


FIG. 6

The calculator PC pattern. Modify as shown and as detailed in the text.

LIST OF COMPONENT PARTS

1 Novus 650 Mathbox calculator
1 Novus rechargeable conversion kit (optional)
1 Plastic instrument case, 160 x 90 x 70mm
1 D type crystal, 1.6384MHz
1 PC board 77 x 75mm, 75sw11a
1 PC board 77 x 77mm, 75sw11b

SEMICONDUCTORS

2 MM74C00—quad 2-input NAND gates
2 MM74C04—hex inverters
2 MM5616—quad bilateral switches
2 MM5617—divide-by-ten counter dividers
1 MM5620—14-stage binary counter divider
1 Small signal diode (0A95, 1N914, etc)
1 Zener diode—4.7 volt

RESISTORS (¼ watt)

2 100k
2 680k
1 270k
1 470 ohm
1 5 megohm
1 4.7k

CAPACITORS

1 .047uF
1 .1uF
1 47pF
1 15pF
1 39pF
1 3-13pF

SWITCHES

1 Push "off" SPST
1 Push "on" push "off" SPST
1 Miniature toggle DPDT
1 Miniature toggle SPST

MISCELLANEOUS

9V battery, hookup wire, nuts and bolts, aluminium for brackets, 25mm spacers, 8-pin connector and socket (optional), PCB, etc.

TROUBLE-SHOOTING CHART

Problem	Source
1. Any peculiar behaviour.	1. Dry joints or dry bridges.
2. The timer runs slowly and "reluctantly".	2. The value of the resistor and capacitor in the oscillator inverter chain.
3. Digit 4 or digit 6 stays on in the display.	3. The speed-up network—the polarity of the diode.
4. The keyboard is disabled when the timer is off.	4. The isolating switch circuits (5616). Digit output connected to K input.
5. Reset clears the calculator but does not enter "1".	5. Battery low, or increase debounce delay by increasing the value of C2 and/or reducing C1.
6 Timer gains.	6. Increase the value of C4 (Fig. 5).
7. Timer loses.	7. Decrease the value of C4 (Fig. 5).

the PCB, in which case Gnd and Vcc should be soldered first to bring protective diodes into operation. In the prototype IC sockets and Molex pins were used.

All CMOS inputs should be connected to the circuit, otherwise they may be affected by stray voltages. In particular, the control inputs of the 5616 switches must be connected to "high" when they are on and "low" when they are off. Unused outputs may be left unconnected.

The NAND gates and inverters are pin-for-pin equivalents of their 7400 TTL counterparts. The MM5616 is a quad bilateral switch which is turned "on" by a high on the control input and "off" by a low. The MM5617 is a divide-by-ten counter/divider with ten decoded outputs. The counter is cleared to zero by a high on its reset line (pin 15) and counts when there is a low on the clock enable input (pin 13). This circuit uses decoded output "9", so that the first output pulse is triggered by the tenth input pulse. The MM5620 is a fourteen-stage ripple-carry binary counter/divider. It is reset to 0 by a high on the reset input (pin 11). The output for this circuit is Q14 (pin 3). The PCB provides for some unconnected outputs to anchor the IC firmly to the board.

Double inverters are used on several 5616 controls. These gates switch from high to low in nanoseconds, and this makes the switches operate cleanly and simultaneously. This speed is needed if two or three hundredths of a second are not to "leak" through.

In layout, it is often more convenient to use a NAND gate as an inverter than to run conductors from one chip to another. This has been done here with the reset circuitry.

Throughout this description "goes high" and "goes low" have been used to indicate "logical 1" and " logical 0" in the digital logic convention.

The calculator and switches are mounted on the front face of a plastic instrument case shown in the photograph. The wiring from the calculator to the converter passes through a 20mm hole under the battery cover.

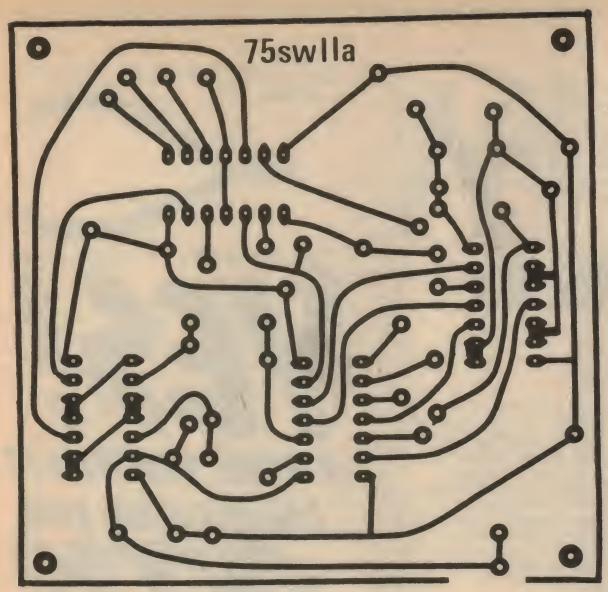
It is advisable to prepare the case first, so that the calculator can be opened once, connected, and secured permanently. Remove the battery cover and the battery from the calculator, slacken the nut on the AC input and remove the four securing screws, and the back can be removed.

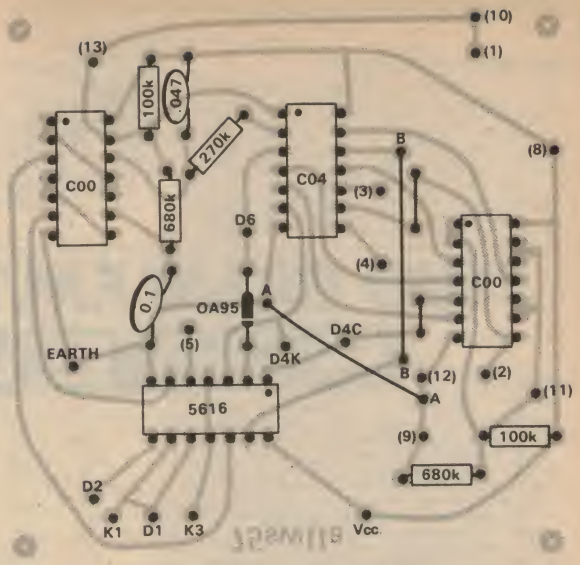
Secure the back of the calculator to the instrument case with two screws. Provision should be made for replacing the four calculator screws from the inside of the instrument case. Make sure the holes for this are large enough to take the screwdriver.

Working from the conductor side of the calculator PCB, drill a No. 60-63 hole beside each conductor at the points shown in Fig. 6. Cut lengths of hookup wire generously, so that they can be worked on from the inside of the instrument case. Strip 3-4mm, insert the wire from the IC side, lay the bared wire along the conductor, and solder. Use plenty of flux and avoid bridges. Label each lead clearly (D1, K1, etc).

Special arrangements must be made for the D4 connections. Cut the conductor to isolate D4 (pin 1) of the calculator from the keyboard and the digit driver, and wire-link the driver and keyboard conductors. Two converter leads are then required—one to D4C (chip) and one to D4K (keyboard).

To switch the decimal point, disconnect the Vcc end of the resistor (the only one on the PCB) and, insulating suitably,

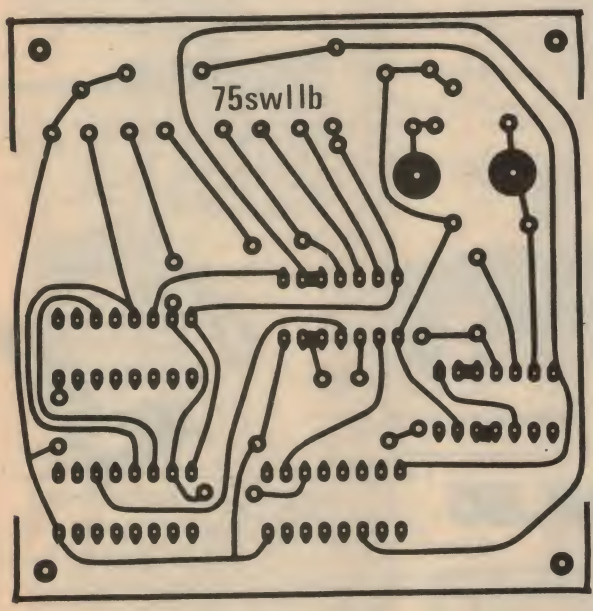




CONNECT (1) TO (1), (2) TO (2) ETC.

FIG. 7 (b)

Fig. 7 (a) (above) shows the control board PC pattern reproduced actual size. Fig. 7 (b) (right) shows the component layout.



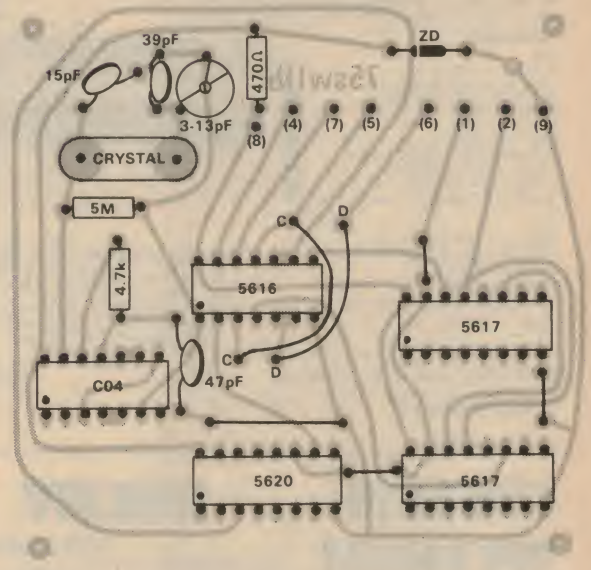
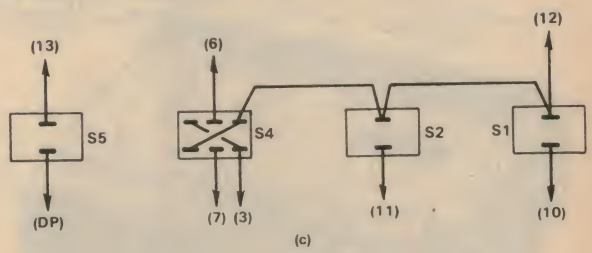


FIG. 8 (b)

Fig. 8 (a) (above left) shows the clock PC pattern actual size, while Fig. 8 (b) (above right) depicts the component overlay. The switch wiring is shown in Fig. 8 (c) at right.



attach a lead to it. Take the Gnd lead from the "controlled" side of the calculator's ON/OFF switch.

Dress the leads up each side of the PCB, tuck each bundle into the "horns" on each side of the display, pull the leads and the battery connector into the instrument case, and reassemble the calculator.

Connect a battery, switch on the calculator, and test whether all is well so far by touching together the free ends of the leads according to Table 1. To do this make a temporary connection of D4C and D4K. The connections to K2, D3 and D5 are not needed for this project, and can be tucked into the battery compartment. In the prototype leads for Vcc, D1, D2, D4C, D4K, D6, K1 and K3 are terminated in an eight pin flat connector, and this simplifies connection and removal of the conversion circuits.

The conversion circuit is on two PCBs—a control PCB and a clock PCB—held together by 25mm spacers. This arrangement makes the clock PCB available for other timing projects. The board and their wiring diagrams are shown in Figs. 7 and 8.

Assembly is straightforward. Note that some wire links are required on each PCB.

The prototype boards were with a Dalo pen. Several conductors run between IC pins. This needs careful penwork, and it is essential to clean up all close conductor runs with a scalpel because bridges, and especially high resistance ones, are the most likely cause of trouble.

Connections to switches and connections between boards, are indicated in the circuit and layout diagrams. Connect labelled calculator leads to indicated points, and connect 1 to 1, 2 to 2, etc.

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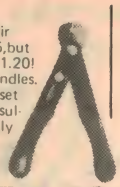

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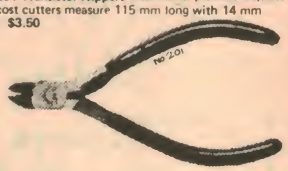

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Selectivity 60dB
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IF Rejection 100dB
Spurious Response Rejection 100dB

AM:
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Selectivity 40dB

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Image rejection 40dB
Selectivity 20dB
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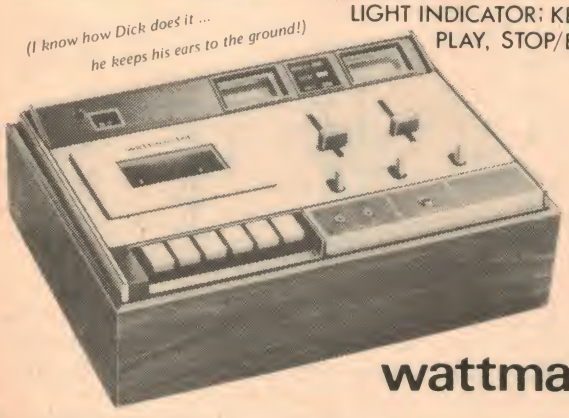

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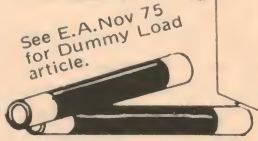
See E.A. Nov 75 for Dummy Load article.



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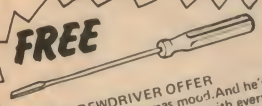

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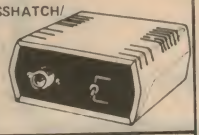

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COMPLETE WITH TRANSISTOR SOCKETS, DIECAST CASE & TRANSISTOR COVERS. See Aug 75 E.A. State wether positive or negative earth required **$17.50** (P & P 75c)

(See EA DEC 72)
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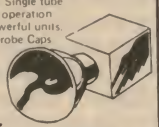
KIT56 High Power Strobe (E.T. Aug 71/25 Top Projects) Ideal for parties, dances etc to create dazzling effects. Uses large 7" satin finish reflector exactly to original specs. Single tube can easily be converted for 2 tube operation. Don't confuse with cheap, less powerful units. Now only $22.50 (p&p $1.00) Strobe Caps 6.5 uf 250V.a.c **$3.50 each**



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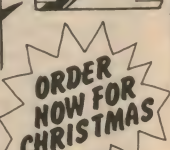
$22.50



ORDER NOW FOR CHRISTMAS

8PAGE MINI-CATALOGUE presented in November Electronics Australia. If you missed your copy then send a stamped addressed envelope and we'll put you in the picture on all the latest tools, TV accessories, Hi Fi, Books, Amateur Radio, Switches etc etc. We'll put a copy in with your order if you ask for one.

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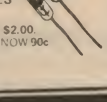

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LM339N as used in this month's ETI project
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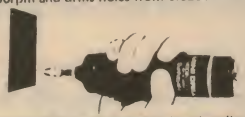
Runs off 4 UM3 cells or 6V dc at 600mA. 2,500rpm and drills holes from 0.0236 to 0.059"



Ideal for all PC work, model makers, jewellers etc. Comes complete with bit for PC use. and plastic carry-case. **$15.75**

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If you're a keen enthusiast or professional, you're going to need a scope and this Trio job is ideal for so many applications. CO1303A is a 3" 15 MHz CRO with 20mV I am sensitivity. Direct input permits displays to 150MHz. We have made a huge $10,000 purchase so we can pass a saving of $33.00 on to you!! Normal trade price is $192.00 but the CO1303A is yours for $159.00. (Road freight $6.00 extra). Special tax free price (BO051E) is $144.00. ONLY WHILE STOCKS LAST SO HURRY... Undecided? See review in E.A. June 74

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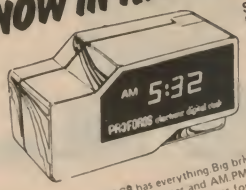
PROFORDS CLOCK NOW IN KIT FORM!

SEE E.A. Nov.75 for full article



An incredible clock the DC8 has everything. Big bright gas discharge display of hours minutes and AM.PM. Auto-zero on switch on. Separate push-buttons for setting hours and minutes plus hold for accurate setting. Electronic alarm to the minute on 24 hour basis. Snooze facility gives 7 minute cycle. 240V operation. Build it yourself or get one ready made.

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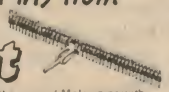
Molex Pins from 1 cent



We've slaughtered the price of Molex pins with this huge purchase. Why risk damage to delicate IC's when you use this professional socket strip (which also helps when servicing)? Available in following lengths

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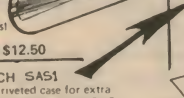

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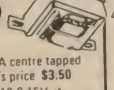

DSE2851 240V ac to 12.6V at 0.15A centre tapped. Normally sells for around $6.50. Dick's price **$3.50**
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Yes! Dick's done it again. Resistor packs, capacitor packs, and now a GIANT 70% saving on brand new top quality axial lead electros. Listing from computer is based on USEAGE not USELESS values!! 50 caps for only $5.00. Check the list

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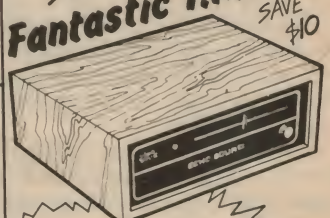
50V	1x1, 1x2.2, 2x4.7, 2x10, 1x22, 1x47, 1x10, 1x220

See 50 USEFUL values (some worth 70c each) yet average price is only 10c each. HURRY for these specially imported packs (not surplus) at only $5.00 for all 50 electros.

AM. FM STEREO/MONO Fantastic F.M. Tuner

SAVE $10



"Very good value indeed" Neville Williams, Electronics Australia, Feb. 75

Don't take our word for it, see the review in Feb. E.A. The Echosound Tuner is incredible value for money. Has separate AM and FM front ends. 10 transistors and 14 diodes. Covers FM 88 to 108 MHz AFC. 60db S/N. 35 db sepn. 600mV output. AM 535 to 1605kHz ferrite rod antenna. Features multiplex adaptor complete with built in stereo indicator. 240V operation. Complete in Walnut case.
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Forum

Conducted by Neville Williams

COVER FEATURE:

The colour balance in your TV set may be all wrong!

You've just paid anything from $500 to $1200 for a new colour television receiver to watch programs brought to you by the most up-to-date system in the world. It is disturbing to realise that the colour balance you are watching may be wrong, not because of any basic fault in your set, but for the want of a few minutes to optimise a relatively simple internal adjustment.

Most people, when planning to buy a new colour set, will have visited a variety of department stores and display centres and gazed in bewilderment at the long line of screens, many of them displaying the same program.

With the multiplicity of models, styles, prices and brands, such displays are bewildering in themselves but one other impression often comes through: quite noticeable differences in the colour content of the pictures. A pallid face on one screen looks normal or even somewhat ruddy on others. An ostensibly white shirt on one set may acquire pastel tonings on others. The occasional black-and-white advert comes through in a bluish, greenish or old-fashioned sepia cast. Timber tones can range from teak to walnut, and so on.

Differences between sets on display tend to be dismissed by the sales staff thus: operating alongside a dozen other sets, and sharing a signal piped from an aerial stuck up on our roof amongst air conditioning ducts, no set on display will be seen at its best.

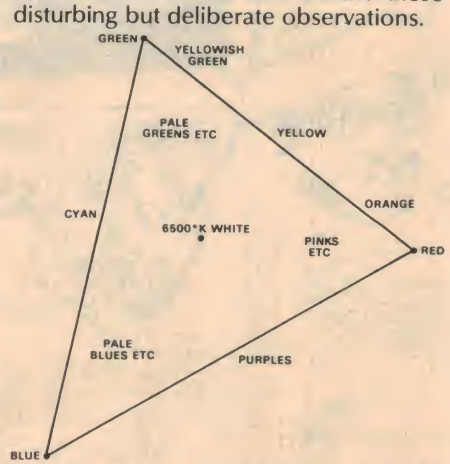
"When we instal one in your home, operating from your own aerial, and our experts have adjusted it precisely for your viewing situation, all the peculiar effects will disappear ... &c ... don't worry ... she'll be right Jack!"

In fact, this is not an unreasonable claim in relation to some aspects of a receiver's performance. Unless you happen to live in a notably poor reception area, connection to a good (not necessarily new) aerial will ensure a picture substantially free from ghosting, and the granular "noise" effects resulting from too little signal. De-gaussing can minimise anomalous tinted areas, AGC adjustment should obviate overload effects, and so on—all part of the attention that should come under the usual $15 worth of "installation".

But, more than likely, internal adjustments to do with the picture itself will not be touched; they are supposed to have been optimised back at the factory.

And amongst those that are usually not touched in the home are the tab potentiometers that determine the relative strength of the colours in the ultimate picture. There is therefore a distinct chance that the receiver you get will be as noticeably bluish or greenish or reddish as some of those you saw on display. Even if you picked a brand because you liked the colour you saw in a demonstration, there is no automatic guarantee that your own set will have the same colour balance. It may or may not, depending on how tight is the manufacturer's (or distributor's) control over adjustment procedures.

At this point, it may be appropriate to look at the technical facts behind these disturbing but deliberate observations.



Considerably simplified, this colour triangle indicates graphically how the three primary colours can be combined to produce a variety of hues, as explained in the text. Only if the receiver is set up to produce the correct standard white will the pastel hues in the central area of the triangle be reproduced as per the transmitted chrominance signal.

In a colour picture tube, three electron guns fire separate beams of electrons towards the screen. The beam from one particular gun should strike only those phosphor dots (or stripes) which glow red when excited; for convenience, this is referred to as the "red" gun. Similarly the "blue" gun excites other dots (or stripes) to produce blue, and the "green" gun to produce green.

If the whole area of the screen is evenly scanned with only the red gun active, the screen will assume a uniform red colour of a hue determined by the precise nature of the phosphor. Similarly for the blue and green guns and phosphors.

How brightly the phosphors glow depends on the intensity of the electron beam striking them, and therefore on the individual beam current. The "illumination" or brightness of the individual phosphor dots or stripes can be varied from quite a high level down to the merest glow—or nothing at all!

A wide range of other hues can be produced by simultaneously activating two or more of the three "primary" colurs. Under normal viewing conditions, the eye cannot resolve individual phosphor dots or stripes. It sees an area from which is emanating certain proportions of red, blue and green, which add visually to produce a particular hue or colour sensation.

If one starts with the red phosphor fully activated, then gradually turns on the blue gun, the optical effect is to shift the red from its initial shade towards—and through—purple. Increasing the blue content, while progressively reducing red will ultimately leave the pure phosphor blue.

Continuing the exercise, but using the blue and green guns, will produce a range of shades from blue, through cyan (bluish green) to pure phosphor green.

Similarly, the green plus red guns can produce tones varying from yellowish green, through yellow to orange and then on to red.

With all three guns activated, the screen tends to produce more pastel versions of the basic "saturated" colours. In fact, with carefully balanced proportions of red, blue and green, the screen can be made to look white, when fully activated, or various depths of grey as all

three gun currents are lowered.

These relationships can be represented graphically in what is called a colour triangle, as illustrated. At the apexes are the three "additive" primaries used in colour television: red, blue and green. Along the sides are the saturated colour mixes produced by blending respective pairs of primaries. Within the triangle are the "de-saturated" colours which result from the blending of the three primaries, with "whites" in the central area.

Theoretically, a television receiver can present to the viewer any hue which occurs on or within this colour triangle. The colours can be as luminous as the phosphor and the beam current will allow, or as subdued (i.e., non-luminous) down to whatever practical limit is set by ambient (i.e., external) light falling on the screen.

In the interests of colour fidelity, it is important that essentially the same primaries be used throughout the entire system—all transmitters, all receivers.

To take a simple case, let's suppose that the chrominance signal (i.e., the hue or colour signal) from the TV station ordains that only the red gun be activated for the background to a title, or for a particular area in a total picture. The result in viewers' homes would be significantly different if the red phosphor in different makes of picture tube variously produced anything from an orange red through to a cerise. Similarly for the other primaries and for any of the mixtures they might produce.

In the early days of colour television, there were significant discrepancies between the phosphor hues chosen by different tube manufacturers, largely because they were seeking a compromise between the hues they would like to use on the basis of colour physics, and practical phosphors which would give them sufficient brightness. Emerging technology has gradually allowed these conflicting considerations to be reconciled and the basic primaries are now reasonably well standardised at both the transmitting and receiving end.

As a result, there should be little to choose between receivers, irrespective of their manufacture, in their basic ability to produce the full and appropriate range of hues. Any small displacement of the phosphor hues will tend mainly to nudge the saturated colours near the perimeter of the triangle, without prejudicing either their subjective appeal or their credibility.

For the unsaturated or pastel hues near the centre of the colour triangle, the precise nature of the phosphors is even less critical, the colours being dependent almost entirely on the voltages and drive applied to the three separate guns—and this is a matter for adjustment in each individual receiver.

Included amongst the unsaturated and pastel hues are scenes and surfaces with which viewers are likely to be most familiar: sky and clouds, playing fields and sporting events, local beach sand and, above all, human skin tones.

And here we come to the whole heart of the matter: if the picture seems to exhibit an overall tint, or the colour balance on familiar scenes is suspect, the problem is unlikely to have much to do with the brand of the receiver, its country of origin or the nature of the picture tube it uses. Almost certainly it will be a matter of internal adjustment. Quite small maladjustment of the tab potentiometers controlling gun voltage and gun drive can change the whole "cast" of a picture and the hue of pastel areas; faces can look unduly sallow (excess green), ruddy (excess red) or bluish (excess blue) whereas, overall, they should conform closely to the normal range of human skin tone.

But what is skin tone? While it is something about which most people will have opinions, it is notoriously unsuitable as the basis for any kind of colour standard. Observation will readily establish that some complexions are indeed sallow, ruddy, sunburnt, swarthy, or even bluish under certain light conditions. What a colour TV receiver has to do is to present them as they are, without superimposing its own artificial quality.

It transpires that the most meaningful basis on which to proportion gun voltages and gun drive in a colour receiver is to ensure that it produces an appropriate white, and appropriate densities of neutral grey when so instructed by the transmitted signal. This will occur predictably during the transmission of test patterns and monochrome programs, and it can be simulated by turning the receiver's own colour control right off.

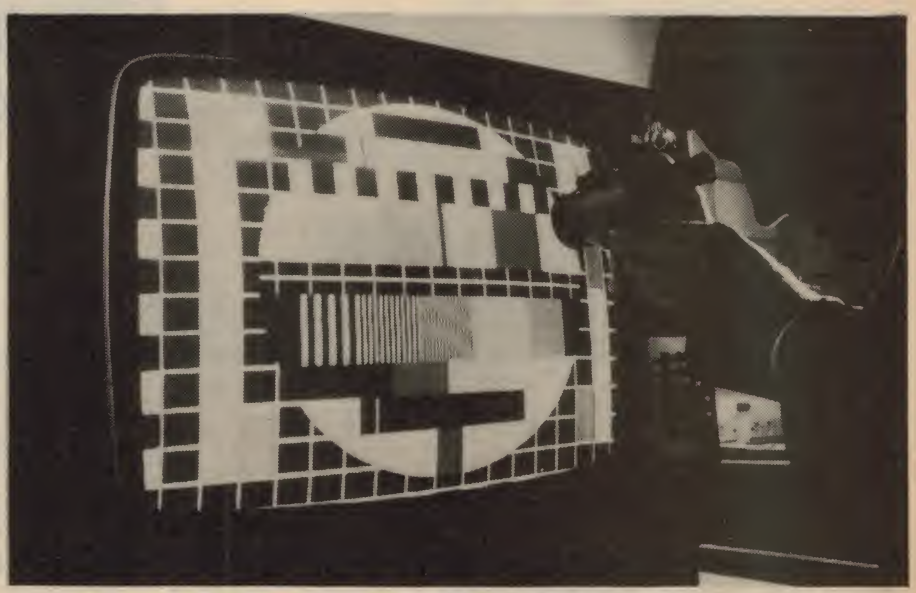
But again comes the question: what is white? The colour of the paper on which this article is printed or some other surface that might be so described? Viewed under what light—daylight, fluorescent or incandescent? Flowing from this is the matter of "neutral" greys.

Just as there has been some divergence over the exact hue from the primary phosphors, so opinions have varied as to what should be regarded as an appropriate white. Nowadays, the television industry is tending to standardise on a reference white defined as "illuminant D" and equivalent to a colour temperature of 6500K (degrees Kelvin). It contains more blue energy than the textbook "illuminant A" reference (a warm white) or "illuminant B" (direct sunlight equivalent) and a different blue-spectrum spread than "illuminant C" (slight overcast equivalent). However, it is less obviously bluish than the "white" from many monochrome picture tubes.

When properly set up, if a TV camera analyses a scene and generates a reference white chrominance signal, the receiver will produce an equivalent area on the screen at a colour temperature of 6500K; under ordinary viewing conditions, the level of the light will be somewhere around 21ft Lamberts. Reference greys from the camera will produce light of the same colour temperature but at progressively lower light levels, right down to beam cut-off, representing zero phosphor activation and subjective "black".

The nature of the deeper greys in a colour receiver depends on the adjustment of "background" or "threshold" or "DC" tab potentiometers controlling the potential on the first anode of each gun. The nature of the lighter greys and ultimate peak white depends additionally and heavily on other potentiometers which serve to balance the signal drive to the guns.

If these adjustments are carried out



The pattern on a colour television screen is produced by patterns of phosphor dots or segments which respectively produce red, blue and green light. For the hues of a complete picture to be correct, it is essential that the signal drive to the three electron guns be precisely adjusted.

TRIO

NEW Trio CS-1560

The 15MHz dual trace with a 10MHz price tag

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	DC volts	2 to 1000V	D.C. current	0 to 200mA
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JPM28

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If you are not delighted with these instruments, return them within 7 days for a refund less delivery costs.

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PARAMETERS PTY LTD

carefully and the full range of greys through to white (i.e., the grey scale) is neutral (e.g., at 6500K), then the whole range of colour values in the central area of the colour triangle must be substantially correct.

Conversely, if the background presets are not accurately adjusted, there will be a colour shift in the shadow areas, with near-blacks being perceptibly tinted. If the gun drive presets are not accurately set—and this is the "crunch" situation—the whites will be tinted. Pastel highlights will suffer a colour shift and flesh tones will tend to be pulled away from the "natural" range.

What this can mean in practical terms is summarised in the following paragraphs. It should be noted that the magnitude of maladjustment assumed is not exaggerated, but of the order actually encountered in supposedly fully adjusted receivers, most of them installed in customers' homes.

TOO MUCH RED: Whites pinkish, as also faces; yellows turn orange, blues become purplish. Probably the least common maladjustment because a reddish cast is usually so obvious.

TOO MUCH BLUE: Perhaps the most common setting error because it has a subjective appeal. Whites look very white, and make colours vivid by contrast; monochrome pictures have a hard black-and-white look; reds take on a richer magenta shade; studio flesh tones have an intimate quality, because veins, shaven areas, &c, show up, often despite make-up. But there are less desirable qualities: film prints with bluish faces come up really blue; furniture and wood panelling looks unnaturally bluish rather than brownish; foliage is seldom lush green, more commonly bluish.

INSUFFICIENT BLUE, equivalent to excess red, excess green: again pictures have a certain immediate appeal because of ample greens, warm yellows, good browns, good timber tones; faces are never blue, even on poor film prints. The limitations come through a little more gradually: the total colour impact suffers because white areas are creamy; skin tones err consistently towards yellow; monochrome pictures come up with a definite sepia cast.

TOO MUCH GREEN: Foliage looks fine and whites are hard and clean, even if somewhat greenish. But skin tones are hard to take, being consistently more sallow than in real life. The effect is worsened if picture aberrations, shadows, &c, also take on a greenish cast.

How common are these failings?

The answer, it would seem, is "too common".

Alerted first by the discrepancies in various store displays, we started asking questions, without finding much reassurance. We then checked on as many receivers as were available in the homes of staff members and relatives, and came up with the disturbing information that more than half of them were improperly set, exhibiting the kind of faults listed earlier. Included among them were receivers which had supposedly been set for a white point of 6500K prior to delivery.

How come?

It would seem that local manufacturers appreciate the nature of the problem and go to some trouble to set the white point as part of the overall adjustment procedures.

The Philips group of companies, for example, use a nest of three photocells, each with an appropriate filter, and each coupled ultimately to a meter. When placed against the face of a picture tube displaying an ostensibly white raster, the meters indicate the proportions of red, green and blue present and permit very precise adjustments to be made to each receiver coming off the production line. The sensitivity of the metering system is adjustable, allowing the proportions to be set at very low light levels (deep grey) and at peak white. If desired, intermediate settings allow the proportions to be checked over the whole light range in between—full grey scale tracking.

Other manufacturers have reference screens set up in the tests booths, allowing the operators to adjust production receivers subjectively to the same colour values.

Then why the differences so plainly evident in store displays, or when sets are brought together in the home?

Are the references subject to drift? Are the operators sufficiently careful? Do the phosphors age or do the electronics drift subsequent to adjustment? Are the manufacturers of overseas receivers as careful as they should be? Do local importers check sets properly before distribution? These emerge as obvious questions when one is faced with receivers which have supposedly been adjusted to an internationally recognised standard, but which are obviously not consistent on the shop floor or in the homes of viewers.

Our impression is that local manufacturers, at least, make provision for setting the grey scale and white point—therefore the overall colour balance—but only a multi-sample survey could establish just how consistent the receivers are from any one manufacturer, or the consistency between different brands, ex factory.

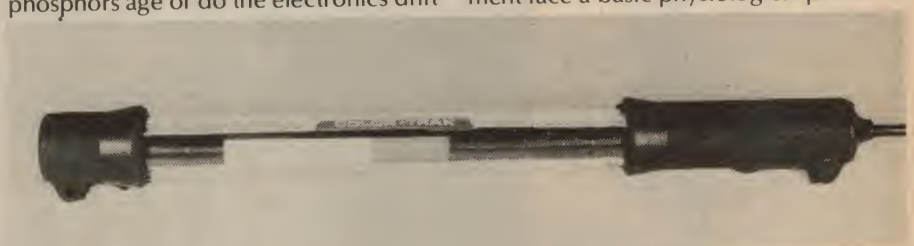
We are far from convinced that the standards are as tight as they should be but, beyond that, there is good reason to believe that discrepancies tend to multiply as receivers move out of the engineering/production environment into subsequent areas: storage distribution, sale, installation and service.

In these areas, depending on the organisations involved, there are people who may have reason to inspect, test run and "touch up" receivers, perhaps effect a last-minute manufacturer's modification, or optimise or correct performance in the user's home. They may even have to face up to a buyer's contention that the colour looks a bit this way or that.

How many of these people have access to, or use, or feel the need for a reference standard?

And how many them happily fiddle the adjustments, confident that they know their colours? I know that some do, but whether they represent a minority or a majority remains to be seen.

Those who would trust to their judgement face a basic physiological problem



The Color-Trak unit, which provides a reference white and grey scale at appropriate brightness and a colour temperature of 6500K. (Parameters Pty Ltd, 68 Alexander Street, Crows Nest 2065.)

Another tool vital for installers and servicemen is a de-gaussing wand for combating magnetisation effects. (As pictured, from A&R-Soanar.)

in that our visual senses tend to compensate spontaneously and automatically for changes in optical environment. We are simply unaware of the degree by which our reference has been shifted until faced with some startling observation: the same incandescent globe which looked quite orange at midday, becomes seemingly bluish in the glow of the setting sun!

Faced with such a degree of built-in automatic chroma compensation, the human eye is scarcely well equipped to make critical subjective judgements on hues. It is highly desirable therefore that anyone, who has reason to question or fiddle the setting of the gun drive pots in particular, has to hand some kind of a white reference light source at a colour temperature of 6500K.

At this juncture, the most obvious—and perhaps the only—portable reference source readily available is the "Color-Trak" unit reviewed in our October issue (p.95). Basically this comprises a specially selected fluorescent tube, in a protective acrylic housing, with an intervening stepped neutral density filter. Thick rubber ends protect the assembly, which is linked through a cord to a shrouded series choke. Plugged into the mains, the Color-Trak provides a reference white at the appropriate intensity, together with a series of greys, all exhibiting a colour temperature of 6500K.

To use the Color-Trak, the operator compares it with the grey scale on a TV test pattern, coming either from a station or provided locally by a portable test pattern generator. Failing that, the colour control of the receiver can be turned right off and the "cast" of the monochrome picture compared with that of the Color-Trak. Adjustments can be made as necessary to the receiver's background and drive controls to bring the greys and whites into line with the reference.

The Color-Trak is not a direct-reading instrument and relies on the skill of the operator to make a subjective comparison between two dissimilar surfaces, one small and smooth, the other large and broken up by scanning lines and a phosphor pattern.

The tasks can be complicated by purity and convergence effects in the receiver which cause very slight tints in certain screen areas, commonly faintly pinkish on one side, and faintly greenish on the other. The operator has to ignore these anomalies and concentrate on the main area, not so affected.

Despite these limitations, an operator using a Color-Trak can get much closer to the mark under a variety of conditions than one who is relying purely on subjective judgement.

If there are any doubts on this score, it is necessary only to react to the Color-Trak itself under varying light conditions. With bright diffused midday light coming into the room, the eyes see the Color-Trak is a conservative, somewhat warm white. It looks "colder" as the Sun begins to set, becoming positively bluish under incandescent light. What it looks like in a fluorescent ambient depends on the tubes in use. The Color-Trak doesn't really change, of course—only the viewer's visual reactions.

Field technician Patrick Quilty checks the white point setting on a colour receiver undergoing a "soak" run at the Pagewood workshops of Trident Television. The Color-Trak reference is resting near the lower edge of the screen. At the time, the receiver was displaying a grey scale picked up from a workshop signal line but the image has been blotted out by the photoflash used to take the picture.

Unfortunately as one service manager remarked to us, "the Color-Trak costs $70 and we're trying to make up our mind whether we can afford to provide our servicemen whith them."

But, while TV companies are making up their minds to provide colour standards—be they Color-Traks or something else again—situations are multiplying which have already happened to two of our own staff members who ran into problems with colour balance in new sets; this was long before the present article had even been thought about.

In both cases servicemen had a look at the set in the home, on the available program material, and agreed that it needed adjustment. Off came the back and pots were nudged until the remark seemed justified: "It looks okay to me now . . . how is it to you?"

Much later, when a Color-Trak became available for reference, one of the adjustments turned out to be almost spot-on, the other obviously too green.

As we worked on the preparation of this article, looking at receivers, asking questions, &c, one impression came through very strongly. Colour is subjectively just as deceptive as hifi sound!

What if all those shiny amplifiers had uncalibrated loud/soft, hi/middle/low pots inside, which salesmen, installers and servicemen were expected to set until they sounded right to their ears on the available program material? What a variety of sound customers would end up with!

And yet that broadly is the position with colour receivers, with their internal adjustments for the dim/bright, red/blue/green aspects of the final picture, as viewed.

What about your colour picture? Are the adjustments spot-on, or does it show some of the symptoms we described earlier?

There can be no sure answer to this, except from a person familiar with the problem and equipped with some kind of instrumentation or visual aid. Unfortunately, people so equipped can't be expected to go round making free calls, unless you can make out a very clear case under warranty.

Don't get us wrong: no amount of adjustment can ensure optimum colour from indifferent films, or other poor quality program material.

The aim of the adjustments is to present to your eyes exactly what the station broadcasts, without some colour cast superimposed by the set itself. If local studio productions are above question, and British television tapes equally good, you can begin to relax. But if the people in those shows are bluer or ruddier than in real life, or if they all seem fresh out of an attack of hepatitis, then you've got troubles . . .

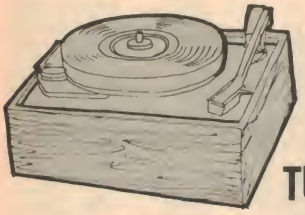
Your set needs prudent pressure on the preset picture pots!

PRE-PAK electronics

SYDNEY: 718 Parramatta Road, CROYDON, N.S.W. 2132. P.O. Box 43, CROYDON, 2132. Phone: 797-6144.

SYDNEY (CITY): 432 Kent Street, Sydney. Phone: 29-7426.

NEWCASTLE: Shops 3-6 West End Arcade, 810 Hunter Street., WEST NEWCASTLE, 2300. Phone: 69-2103.



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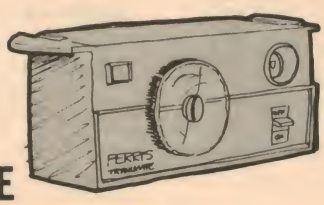
M110 Crystal, mono Jap. type	$1.80	$1.50	$1.20
MC-110 Ceramic, mono Jap. type	$1.80	$1.50	$1.20
M-241 Crystal, mono Ronnette	$2.00	$1.55	$1.33
S-144 Crystal, stereo Jap. type	$2.60	$2.15	$1.71
S-243 Crystal, stereo Ronnette	$3.00	$2.50	$2.00
SC-304 Ceramic, stereo Sonotone	$3.80	$3.20	$2.50
SC-310 Ceramic, stereo BSR C-1	$3.80	$3.20	$2.50
SC-303 Ceramic, stereo BSR SX-5H	$3.80	$3.20	$2.50

Orders may be for assorted types.



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R.F. booster for transistor radios. Pulls in stations 100's miles away.

The fantastic Tranimate is a 2 transistor tuned RF amplifier (patented design) for use in the car or in country areas to boost portable transistor radios so they will pick up distant or weak stations. Connects easily to any transistor radio, operates on 9V No. 216 battery (not supplied). WAS $8.95.

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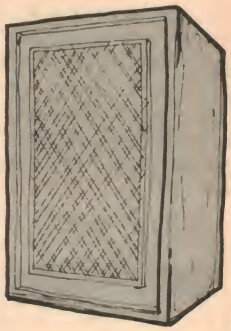

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If you want to build your own loudspeaker, but don't fancy yourself a master cabinet-maker, we can offer you a speaker box kit which isn't really a kit. We've taken all the back-breaking time consuming work out of your hands to make it easier for you.

Here's how:—

Firstly, we supply the cabinet shell ready-assembled and finished — no wood-work, edging or staining and polishing needed.

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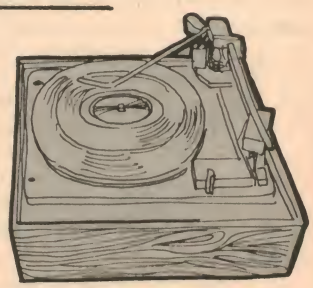
YOU CAN DO IT TONIGHT!



GARRARD 6-100

Complete STEREO CHANGER $65.00 Pack/Post $5.00. A low-price turntable which includes base and cover, mains lead, output leads and ceramic cartridge in one neat package. Recommended price is $71.95, you save $6.95.

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Ready to play STEREO CHANGER $69.00 Pack/Post $5.00. This popular model has most of the features of much dearer turntables at a very affordable price — you will save $10.95 on the recommended price of $79.95.

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SYDNEY (CITY): 432 Kent Street, Sydney. Phone: 29-7426.

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SPK – 10 CABINET

Popular size for all small speaker systems. Pack and Post $2.00. Size 470 mm x 306 mm x 220 mm. We supply ex stock, SPK-10 or SPK-20 Kits for popular speakers as listed. Others: advise speaker size etc. Available within 24 hours. Speaker kits sent freight collect.

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PLESSEY 12" 3 way (D) 30 watts **$69.00ea**
CORAL 10" 3 way 25 watts. **$58.00ea**
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All kits include crossover networks etc. (D) Signifies PLESSEY or PHILIPS 1" Dome Tweeters supplied

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TT750	NPN	low level amp	25	150-450	16c
TT751	NPN	low level amp	25	150-450	16c
TT752	PNP	GP amp/switch	45	30-130	17c
TT2116	NPN	LN low level amp	25	60-900	16c
TT2117	PNP	GP amp	25	30-300	16c
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10-49 less 10%, 50-99 less 15%, 100-249 less 20%, 250-499 less 25%, 500+ less 33%.

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MC770 BCD to decimal decoder	60c	48c	30c
MC780 Decade up counter	60c	48c	30c
MC786 Dual 4 input expander	20c	16c	10c
MC788 Dual 3 input buffer	60c	48c	30c
MC789 Hex invertor	20c	16c	10c
MC790 Dual J-K flip-flop	40c	32c	20c
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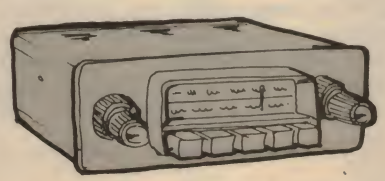

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Extra powerful, long-range reception.
Features 9 transistor design

2 watts (approx) output	WAS $33.50
RF amp front-end	XMAS SPECIAL
Tone control	$26.60
Push-button or manual tuning.	

Exclusive to Pre-Pak, this popular kit incorporates a Philips high selectivity, pre-aligned and assembled, RF-IF module for easy construction. The push-pull output stage delivers adequate volume with good tonal quality. Designed and previously made in Australia. Now only $26.60 freight approx $3.00. Supplied with aerial and speaker. extra $5.00.

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ETI-309 auto battery charger	$39.50 P P $5.00
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ETI-313 car alarm system	$14.50 P P $2.00
ETI-301 vari-wiper for cars	$10.90 P P $1.00
ETI-111 1.5-15V 1A power supply	$19.50 P P $3.00
ETI-520 digital stop watch	$95.00 P P $3.00
ETI-401 4 input FET mixer	$29.95 P P $3.00
ETI-419 pre-amp/mixer for ETI-413	$ 9.95 P P $0.75
ETI-413 100 watt guitar amplifier	$69.00 P P $6.00
ETI-422 50 watt stereo amplifier	$120.00 P P $6.00
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Vortex rec/play pre-amp	$29.00 P P $2.00
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2 transistor radio	$ 4.95 P P $0.75

Bucket brigade device for audio time delays

A new MOS integrated circuit has recently become available in Australia. The MN3001 is a "bucket brigade" device which is capable of providing a time delayed replica of an analog input signal. The device has applications in providing reverberation and tremolo effects, and can be used in audio processing applications to prevent loss of initial transients.

by DAVID EDWARDS

Readers may recall the Forum article in the April 1972 issue, in which the question of an electronic audio delay system was discussed. Discussion centred around a unit which achieved an audio delay by digital means. This involved an analog to digital conversion, followed by a digital delay system, and finishing with a digital to analog conversion. The price of this unit was in excess of $5000.00.

The article concluded with the hope that eventually a way would be found to reduce the component count, increase the delay and, at the same time, reduce the cost by a substantial amount. Now, nearly four years later, this hope has been realised.

This has been made possible by the release of a new MOS integrated circuit, the MN3001. This is a dual 512-stage bucket brigade device, or BBD, suitable for use as an audio delay system. It is being marketed in Australia by Elcoma, the components division of Philips Industries Holdings Limited. The price in one-off quantities is $15.55 plus tax.

Before explaining the operation of this device, or BBD, is a form of analog shift remarks are in order. A bucket brigade device or BBD, is a form of analog shift register. Imagine a long line of capacitors, arranged with a switching network so that each capacitor can receive a charge from its neighbour on the left, and pass it on to the right. The rate at which the charges are transferred is known as the clock rate.

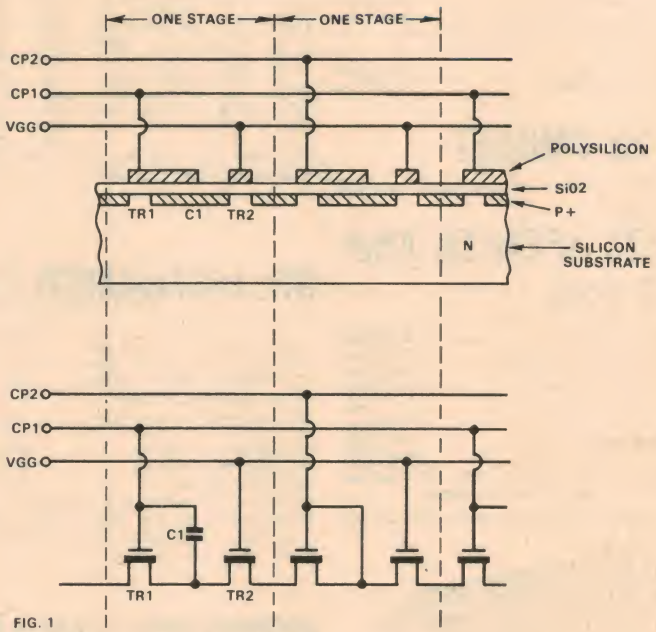


FIG. 1

If the first capacitor in the line is given a charge during the first clock period that is proportional to some input waveform, and if this charge is updated during every following clock period, then a train of charges will appear at the end of the line, with a delay dependent on the number of stages and the clock frequency. This train of charges will be a delayed replica of the input signal.

The difficult part of this scheme is in efficiently transferring the charges from one capacitor to the next, as any lost charge will be apparent as noise or distortion on the output waveform. The delay that will be achieved is given by the product of the number of stages and the clock period, while sampling theory sets the maximum bandwidth as equal to one half of the clock frequency.

This means that there is a compromise between the bandwidth of the delayed signal, the amount it is delayed, and the number of stages to be used. For a given number of stages, we can have either a large bandwidth and a short delay, or a long delay and a small bandwidth. The maximum number of stages that can be used is set by the rate at which charges are lost as they are transferred. This will determine the final system noise and distortion.

With these basic parameters and limitations in mind, we can now turn our attention to the MN3001 device itself.

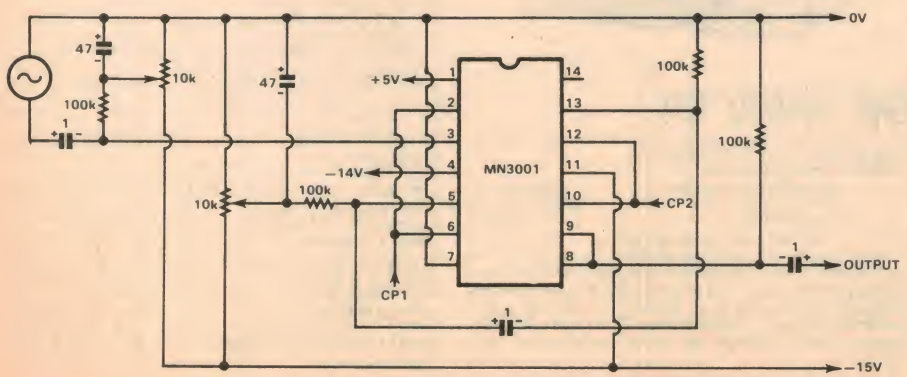


FIG. 2 BASIC 1024 STAGE ELECTRONIC DELAY

P-channel silicon gate technology is used to fabricate two MOS transistors and a MOS capacitor for each stage. There are 1024 of these stages, arranged as two independent BBD chains, each 512 stages long. Each chain is provided with separate clock terminals, so it is possible to use them with differing clock frequencies.

Fig. 1 shows the physical construction of these stages, and also gives the equivalent circuit diagram. Two clock signals are required, with the second one opposite in phase with respect to the first one.

The final stages in each BBD chain differ from Fig. 1 in that two outputs are made available. The second output is delayed one extra stage, and is arranged so that when the two outputs are summed, the clock components in the outputs cancel, while the signal does not. This means that much less filtering is required to remove the clock components from the output.

Turning now to Fig. 2, we can examine the circuit of a practical delay system in detail. Three different supply voltages are required to power the MN3001, +5V, −14V and −15V. We will give details of a suitable experimental power supply later in the article.

The input signal is AC coupled via the 1uF capacitor to pin 3, while the input bias is determined by the setting of the 10k trimpot. Optimum performance is obtained with a bias voltage of approximately −4V. The output from the first BBD chain (at pin 13), is connected to the input of the second chain (pin 5), via a second coupling and biasing network.

The two outputs from the second chain are summed across the 100k resistor, and the output AC coupled. For optimum performance, a high impedance (greater than 100k) load should be used. The same clock signals are fed to both chains, as shown.

This basic unit will give a single delayed replica of the input signal. The delay time is dependent on the clock frequency, and can be calculated using the following expression:
delay (ms) = 512/clock frequency (kHz).

Since the delayed signal has been effectively sampled at the clock frequency, it is restricted in bandwidth. In practice the highest useable signal frequency which can be passed through the delay line is one third of the clock frequency.

The input signal should be band-limited to less than one third of the clock frequency, to prevent spurious sub-harmonics from being generated by interaction with the clock frequency.

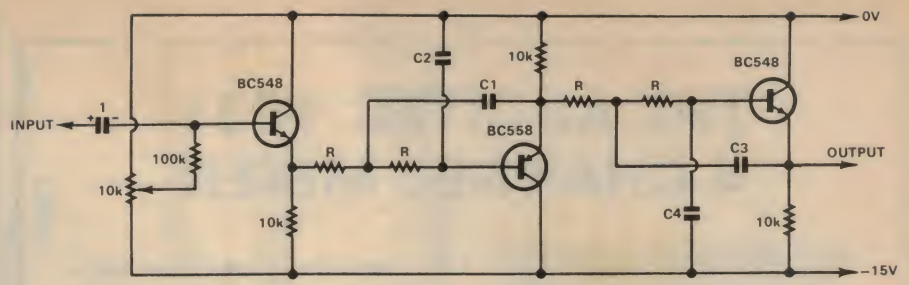
Fig. 3 and the associated table gives details of a fourth order low pass filter, which is suitable for use in eliminating spurious clock pulses from the delayed output. It can also be used to band limit the input signal, if this is necessary.

The filter can be implemented using low cost plastic pack transistors, such as the BC548/558 types. The accompanying table gives the values of the frequency determining components for various cut-off frequencies. If required, the values for frequencies other than those listed can be found by interpolation.

The 10k bias pot should be adjusted to give −7.5V at the emitter of the output transistor. Overall gain in the passband is approximately unity.

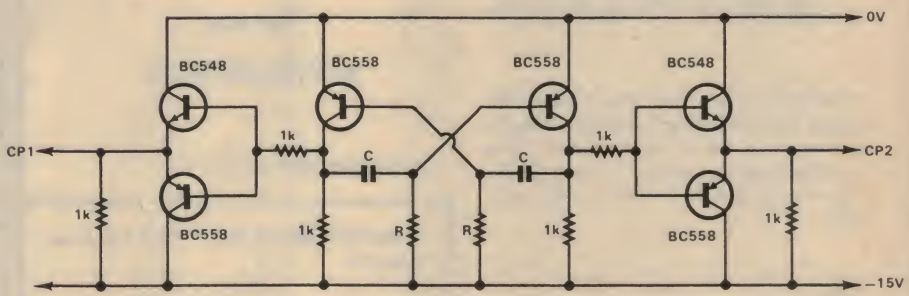
Fig. 4 and the accompanying table gives details of a simple two phase clock circuit with drivers, which can also be implemented using low cost transistors. The table gives the required values of R and C needed to achieve various clock frequencies. Construction is not critical, although the supply rails should be well decoupled, to prevent spurious signals from reaching other sections of the circuit, such as the filters.

Details of a suitable experimental



R	C1	C2	C3	C4	Fc
12k	2310pF	340pF	960pF	820pF	15kHz
12k	1730pF	250pF	720pF	610pF	20kHz
12k	6930pF	1020pF	2880pF	2460pF	5KHz

FIG. 3 FOURTH ORDER LOW PASS FILTER (−24dB/OCTAVE)



R	C	Fcp
47k	100pF	180kHz
47k	220pF	80kHz
47k	470pF	40kHz
47k	.001	18kHz

FIG. 4 BASIC TWO-PHASE CLOCK

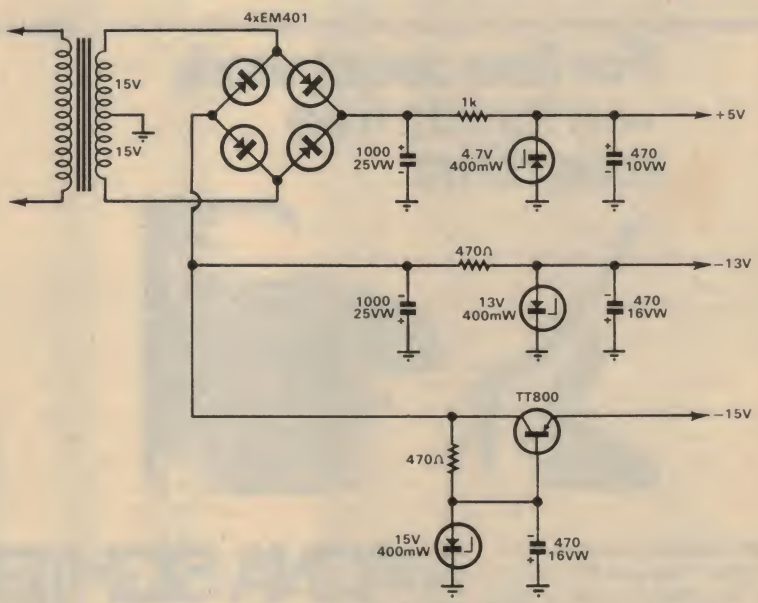


FIG. 5 POWER SUPPLY

Audio time delays

power supply are given in Fig. 5. The +5V and −13V rails are intended solely to supply the MN3001 device, while the −15V rail has been given a larger current capacity to allow it to drive other sections of the circuit, such as the clock generator and filters. Provided the series pass transistor is used with an adequate heat sink, it should be capable of supplying in excess of 500mA.

The MN3001 has a typical attenuation of about 8.5dB for each 512 stage chain, so the configuration shown in Fig. 2 will have a total attenuation of about 17dB or 1/7th. To make effective use of the delay, this loss will have to be made up. Fig. 6 gives details of a variable gain amplifier, which can be used to ensure that the complete system has a gain of 0dB, or unity.

Fig. 7 shows how the basic elements we have described may be utilised to form a practical delay system.

Using this configuration, with a clock frequency of approximately 17kHz, we obtained a delay of 30ms. The cut-off

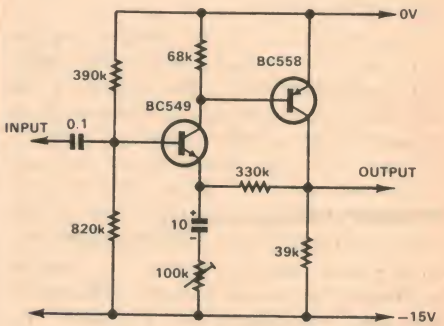


FIG. 6 VARIABLE GAIN AMPLIFIER

frequency of the low pass filter was set at 5kHz, and the signal to noise ratio, measured at the output of the amplifier, was about 50dB. Inspection of the noise component showed that it mainly consisted of clock frequency components, so that with a filter having more attenuation in the stop band, even better performance could be expected.

The configuration described so far is only capable of providing a single fixed period delay. The main application of such a delay would be in dynamic audio signal processing devices, where some characteristic or characteristics of the system are altered in response to a change in the input to the system. Automatic level control systems, voice operated switches and dynamic noise filters are examples.

A fixed delay, such as provided by the MN3001, can be used to ensure that initial transients are not ignored by such systems. This is done by passing a delayed signal through the system whose dynamic response is to be altered, while using a non-delayed signal to generate the required control signals.

To use a delay setup of this type as a means of adding tremolo to a signal, it

is necessary to cyclically vary the delay. With the BBD device, this can be easily implemented in principle by providing a clock signal which is frequency modulated. Provided the depth of modulation is not excessive, the delayed output will be rhythmically varied about a mean delay. Audibly, this will be apparent as a rhythmic shift in the phase of the signal: ie., as tremolo.

Fig. 8 shows a simple scheme for modulating the clock oscillator. A simple phase shift oscillator is used to generate either a 7Hz or a 1Hz approximate sinusoid, which is fed through a buffer to a 1k resistor in series with the 47k clock oscillator base return resistors (Fig.4). To ensure reliable operation, it may be necessary to adjust the 5.6M bias resistor of the oscillator. We found it desirable to switch the frequency determining capacitors, so that two different rates could be obtained at will.

The 220k buffer driver bias adjustment must be set so that a symetrical swing is obtained. The depth control is normally set so that a 440Hz tone is given approximately plus and minus 180 degrees of phase shift.

Switch S1 will disable the tremolo effect. The 100k trimpot in the oscillator can be used to give a vernier adjustment of the speed. It should be emphasised here that this system is only experimental, and can no doubt be improved upon considerably. Even so, it appeared from comparisons with the type of tremolo normally fitted to organs, that this system is capable of good results.

Fig. 9 shows the basic elements of a reverberation system using the MN3001. This is essentially a feedback loop about a fixed delay system. Let us suppose that the gain is adjusted so that the loop attenuation is X dB, and that the delay is D msecs.

If we consider an input signal to the system whose duration is short compared to the delay time, then a series of replica signals will be obtained at the output, with each one delayed by D msecs with respect to the previous one, and also smaller by a factor of X dB with respect to the previous one. This is explained diagramatically in Fig. 10.

It can be seen that the output signal is composed of a series of echoes, diminishing in amplitude. If the original signal has level 0 dB, and if the smallest perceivable echo has amplitude −N dB, then the time taken for the echoes to become insignificant will be ND/X msecs. This is known as the reverberation time.

With a basic system delay of 30 msecs, and with a 50 dB signal to noise ratio, we achieved reverberation times greater than 2 seconds. This corresponds to a system loss of less than 1 dB. The gain of the variable gain amplifier must be adjusted carefully to achieve this level of performance: too much gain, and the loop gain exceeds unity, with the consequence that the system becomes unstable.

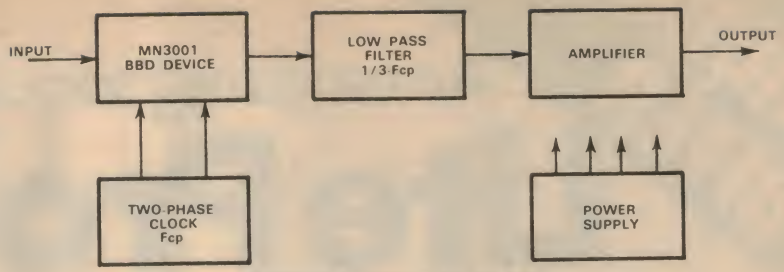
Under steady state sine wave conditions, some interesting results are obtained. With the loop gain set to give a long reverberation time, a frequency response plot shows a large number of repetitive peaks and troughs. These occur because a fixed time delay gives different phase shifts to different frequency signals, so that while some signals are fed back in an additive mode, others are fed back in a subtractive mode.

Due to this effect, a simple reverberation system like that in Fig. 9 is not really suitable for providing artificial reverberation. It is for the same reason that commercial spring reverberation systems use two separate and dissimilar springs in the one assembly.

The equivalent procedure for use with the BBD device would be to provide two separate delay systems, each with a differing delay. This would require two clock frequencies, not harmonically related. One possibility that comes to mind is to use the separate halves of one MN3001 as distinct delay systems, rather than use them together as we have done.

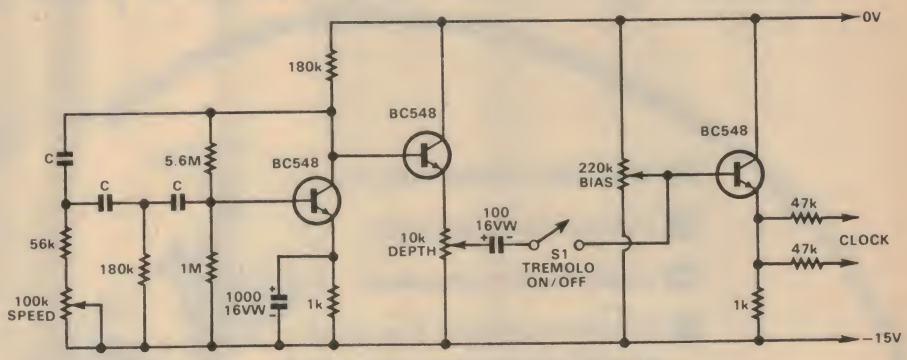
A few remarks are in order concerning construction procedures. The MN3001 is a MOS device, and is susceptible to damage from stray charges, so care is required when it is being connected into the circuit. Perhaps the safest procedure is to use an IC socket, and to insert the device only after all other construction is finished.

In all other respects, experienced experimenters should not encounter any difficulties. There are no doubt many more uses for the MN3001 other than those we have mentioned, so we will leave it up to individuals to experiment further.



SYSTEM DELAY (msec) = 512/Fcp (kHz)
SYSTEM BANDWIDTH = 1/3Fcp

FIG. 7 PRACTICAL ELECTRONIC DELAY



7Hz RATE C = .068 1Hz RATE C = 0.47

FIG. 8 CLOCK MODULATOR — FOR TREMOLO EFFECTS

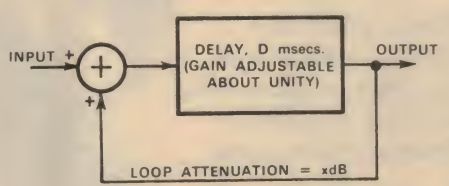


FIG. 9 BASIC REVERBERATION SYSTEM

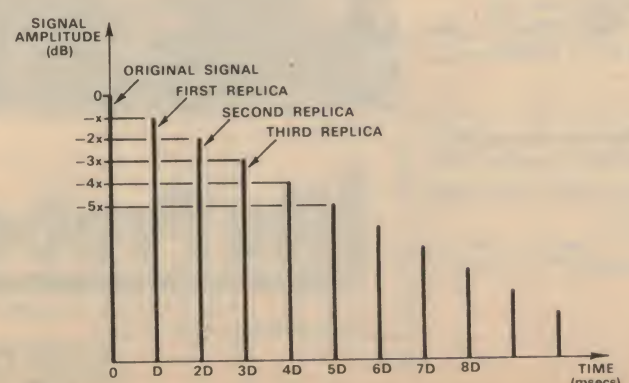


FIG. 10

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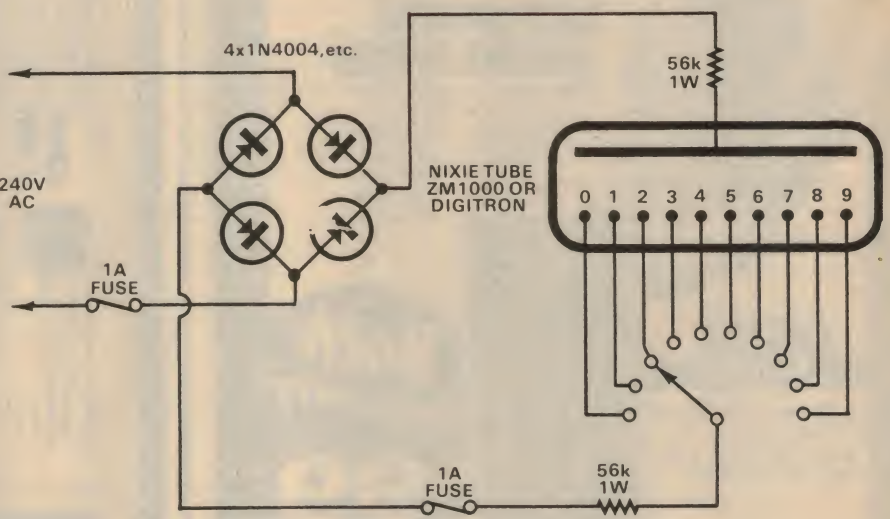
Simple educational device

This is a simple device which is intended to teach children to recognise numbers. It consists of a Digitron or Nixie tube, a switch and a power supply. It can teach a child to count to 10 long before he goes to school. The device has been much in demand by our local kindergartens and child minding centres.

I built the complete unit into a plastic box and I earthed the spindle of the rotary switch. To avoid the possibility of learning parrot fashion, I staggered the number switch connections, e.g., 1, 7, 4, 6, 8, etc.

(By Mr. B. G. Wriede, CEI No. 1 Division, Telephone Exchange, Bundaberg, Qld. 4670.)



Editorial Note: The above is submitted as an idea for readers and it must be stressed that as children are involved, great care should be taken from a safety viewpoint. The device should always be under the supervision of an adult. If a plastic case is used it should be of high impact quality, to avoid the possibility of breakage. If a metal case is used, it must be earthed. Also, an added precaution would be to fit an insulated flexible coupling to the switch shaft. An isolating transformer could also be used, so isolating the secondary from earth. The transformer need only be a small one, with a 240V primary and a secondary of from 150V to 250V. In the case where a secondary voltage below about 240V is used, the two 56k resistors should be proportionally reduced, to maintain the tube current and so the brightness.

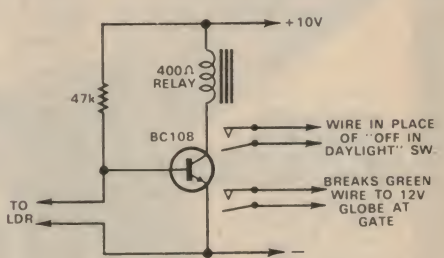
Improvements to Pathfinder Unit

Here are some improvements to my Pathfinder and Visitor Alert Unit as described in Electronics Australia for September, 1975. It is now fully automatic and involves an additional relay, transistor and a light dependent resistor.

One pair of relay contacts in the unenergised position take the place of the inhibit switch, thus preventing the 240V outside light coming on in daylight. The second pair of contacts perform a similar function for the house number light. In this case, the contacts break the green wire to the gate. Precautions regarding the relay contact ratings and insulation resistance apply as before. The 47k resistor may need adjustment, dependent on the ORP12 and its position as regards light.

The LDR, an ORP12, is mounted in any convenient position exposed to daylight (but not to direct sunlight) and is wired back to the transistor base and emitter. The low resistance of the LDR in daylight conditions is insufficient to forward bias the transistor. However, as darkness approaches, the LDR resistance rises steeply and the forward bias is sufficient to turn on the transistor, the relay contacts close and the house number light comes on. Then, if the gate is opened, the sequence of events follows that of the original article.

A second bezel and globe has been fitted in the place previously occupied by the "light off in daylight" switch and



wired up to indicate "power on". This addition to the original unit has been most worthwhile and with the same order of reliability.

(By Mr K. F. Ford, 58 The Point Road, Woolwich, NSW 2110.)

Front end protection technique

Input transistors (FETs or bipolars) are subjected to high levels of RF energy when used in the vicinity of transmitters. Antenna-relay leakage in transceivers, or in mating transmitters can allow prohibitive amounts of RF voltage to reach the input stage of the receiver. A means of protection for the receiver is preferred by most builders. Some amateurs simply place two diodes back-to-back across the low impedance input of the receiver. When the level of RF voltage rises beyond the conduction point of the diodes they saturate and provide a short circuit to the incoming RF energy.

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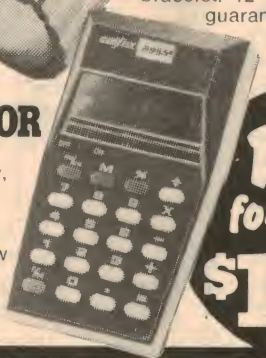

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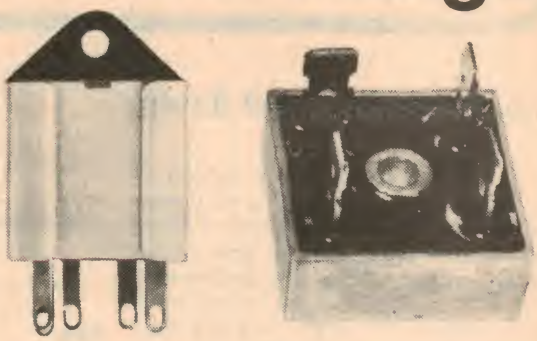

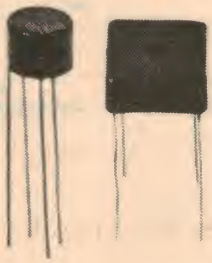

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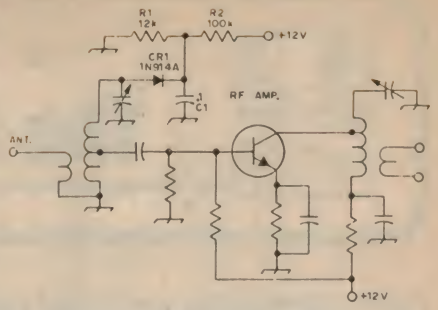
However, when strong out of band signals are present it is possible for the diodes to rectify and cause spurious responses to be heard in the receiver output. Furthermore, when diodes are bridged across the low impedance part of the input tuned circuit there can be considerable RF voltage at the high impedance end of the tuned circuit before the diodes saturate. The value of peak RF voltage can become high enough to damage the input transistor.

While modifying a Hallicrafters TR-35A receiver, a protection circuit was noted which should be superior to the above-mentioned technique. A switching diode is placed at the high impedance end of the input tuned circuit. It is reverse biased by voltage taken from divider R1-R2. When RF voltage peaks exceed the amount of reverse bias applied, CR1 conducts and allows C1 to become part of the tuned circuit. At that time, the input circuit becomes grossly mistuned,



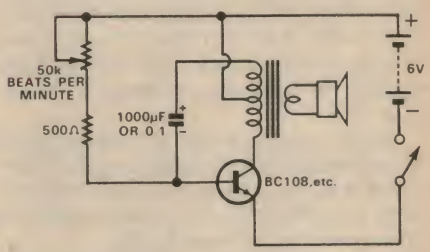
preventing the RF voltage from rising to dangerous levels at the base or gate of the transistor.

(From "QST".)

Metronome or code practice oscillator

This very simple battery operated transistor oscillator can be made to operate equally well as a metronome, or as an audio oscillator which may be used for Morse code practice. By using a 1000uF electrolytic capacitor, the beats may be varied with the 50k potentiometer, from about 30 per minute to well over 300 per minute. By using a 0.1uF capacitor, the tone may be varied by the 50k potentiometer, when used in the role of an audio oscillator for code practice, etc.

(By Mr S. Littlewood, 32 Callaghan Street, Parkes, NSW 2870.)



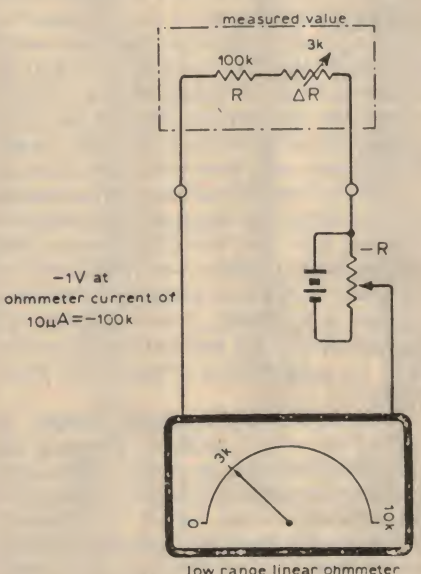
Editorial note: No details have been given for the transformer, but we imagine that a small centre tapped transistor audio output transformer, about 400 ohms to voice coil would suffice.

An alternative to Wheatstone bridge

When a small resistance variation must be measured in the presence of a large fixed resistance, the Wheatstone bridge technique is usually used. A better way, which eliminates balancing and/or output voltage signals which are a non-linear function of resistance change, is the use of a linear ohmmeter and negative resistance cancellation of the high fixed resistance value. A linear ohmmeter produces a constant current at its terminal voltage signals which are a non-linear function of resistnace change, is the use of a linear ohmmeter and negative resistance cancellation of the high fixed resistance value. A linear ohmmeter produces a constant current at its terminals. This allows the use of a potential as a negative resistance because the fixed current holds the Q-point of the battery or source of potential at some constant negative resistance value. Then the ohmmeter may be used on a low range (on which it would be pegged without the bucking voltage) to show the small resistance value change.

In the example shown, a battery and low-resistance potentiometer is used as a variable voltage source to produce the negative resistance value to cancel 100k of the unknown's total value, allowing the variation value of 3k to be read on the 10k range of the linear ohmmeter.

The linear ohmmeter may be any commercial instrument, such as the digital instruments available with resistance measuring ranges. (By David R. Schaller, in "Wireless World".)



low range linear ohmmeter

Longer life for circuit board etchant

Storing ferric chloride etchant (the type used for etching printed circuit boards) in a refrigerator will prolong the usefulness of the solution. Chilling the etchant causes precipitation of free copper to the bottom of the container as "mud". The clearer liquid can be poured into another vessel and the "mud" then washed out of the original container with clean water.

(By W. H. Fishback, in "QST".)

The Serviceman

How fortunate can you be?

"Bringing your work home with you" is supposed to be the wrong thing to do in some circles but it is a way of life to the average serviceman operating his own business. In a recent situation, however, the phrase had more than the usual connotations for me.

The story began when a recent arrival to the district walked into the shop and asked me whether I could help him with his 25-inch B & W TV set. It was a well known brand which had been giving trouble for some time with a loss of picture sync.

Being a person with a semi-technical background he had fiddled with it himself and had a couple of servicemen look at it, all without avail. "It still mucks up spasmodically", he explained.

Since he and his wife were going overseas for a few weeks, he suggested I bring the set in and run it in the house for a while to see the problem for myself. The usual kind of service call had proved futile because the "cures" had proved to be temporary only.

When I brought the set home and juggled it into the utility room, Mrs Serviceman was strangely cooperative. I suspect she saw some hope of our own receiver being given a long overdue overhaul but, as it transpired, the mood was destined to change.

At first, the customer's set behaved quite well, giving a particularly good picture, but then it began to "muck up" as he predicted it would. Sometimes the picture would roll, sometimes it would tear; as often as not, it would do both. Clearly, it had some kind of a sync problem.

But, because it happened only occasionally, and usually when I felt disinclined to do anything about it, I would simply walk over and touch up the hold controls at the back—an exposed pot shaft for the vertical and a small screwdriver which I left in position, supported by the horizontal hold tab pot.

It was the need to keep on doing this that finally caused Mrs Serviceman to threaten to "put my foot through that stupid set"—a threat that was repeated on a number of occasions.

This couldn't last, of course, and one night I pulled the back off the set intending to do something about the trouble (not too much, mind you).

Since the trouble seemed to affect both vertical and horizontal hold, I tended to blame the sync circuitry first. Hopefully, it would be something easy, like a valve or a socket. So, first off, I pulled all the accessible valves out of their sockets, squirted the sockets and pin holes with an anti-moisture, anti-corrosion liquid, worked all the valves in and out a few times, and switched the set on again.

Eureka! The respective hold controls seemed to lock more positively than before and we watched the set for the next two evenings without a hint of trouble.

That's a fair kind of a test run and, in ordinary circumstances, I might have been tempted to consider the set "fixed" and return it to its owner. But the very next evening the trouble was on again, in an almost repeat performance.

The picture seemed less inclined to roll but it did tear from time to time, despite careful setting of the "screwdriver" horizontal hold control. So off came the back again and, this time, I patiently went through the horizontal setting-up procedure as detailed in the service notes for the model: disable the AFC, adjust the horizontal stability coil, "float" the picture, etc., then restore to normal.

In fact, the horizontal adjustments proved to be way out and it seemed little wonder that the circuit had been acting up. So, when I restored normal operation and watched a rock steady picture for a couple more nights, I was all prepared to pronounce the receiver cured at last and to postulate a theory for these notes:

Trouble had been caused initially by fouled valve pins, probably affecting the amplitude of the sync pulses. This made both circuits uncertain in their behaviour. Somebody, in an effort to improve things, had fiddled the horizontal setting up, without going through the whole procedure. In fact, it had only made things worse and, as often as not, when the horizontal flipped out, it also tended to flip the vertical.

All I had really done was to clear the valve pins and restore the set to normal operation. I could file another notch in the handle of my screwdriver!

There was just one flaw in this neat theory: a couple of days later, the picture tore again while Mrs Serviceman was watching her favourite afternoon show and she told me about it in no uncertain terms. If I thought she was going to spend her days fiddling with that stupid screwdriver, I had another think coming! Clearly the time for easy answers had passed: I may have cleaned up a few loose ends but a major problem still remained. I had to take time off and have a proper look at it.

So to the circuit and some straight thinking. It probably wasn't a sync problem because the vertical circuit was now quite stable. There had to be a fault in the horizontal oscillator or its control circuitry, which caused it to tear in one direction or the other, producing lines maybe an inch apart across the screen.

What component would be the most likely suspect?

Then my eye lighted on a pair of selenium rectifiers providing the control bias for the AFC. Selenium rectifiers in this day and age? Good grief! If either or both them was intermittent, or down in efficiency, the control voltage would be unreliable and the oscillator might flip every which way—which was precisely what it seemed to be doing.

It was only a few moments' work to remove one end of each rectifier element and to check it with a multimeter. Both gave suitably different readings when the test prods were reversed but how reliable they were I didn't have a clue. But I didn't care either!

I grabbed a couple of germanium diodes from the oddment box, checked them with the meter to make sure that I didn't get the polarity confused and installed them in place of the selenium elements. Then I checked the setting up, screwed the back of the set on again and sat back to observe the result.

Perfect! Even Mrs Serviceman was happy, because the picture seemed to be quite normal for days on end.

As far as I was concerned, it seemed to be normal for nights on end, except for one small thing: every now and again the picture would break up for an instant, just as if there had been a momentary transmission fault. The occurrences could have been passed off as such, except that there seemed to be too many "faults" in too many transmissions! Clearly, the set was still suspect.

Then came the evening when it failed altogether: no picture and sound only when switched to adjacent blank channels. Fairly obviously, the horizontal deflection had failed, killing the picture and upsetting the sound by virtue of the keyed AGC system. When I took the back off the set and switched on again, I was greeted by a line output valve very red in the face and it seemed abundantly clear that the horizontal oscillator had dropped out. This was confirmed when a check with the multimeter indicated no negative "drive bias" on the horizontal output grid.

Pulling the line oscillator valve and

reinserting it restored the set to normal but there was now no further argument about the existence of a subtle but chronic fault. So I sat and studied the particular section of the board and the related circuit diagram.

Then my memory stirred. Right there in the oscillator circuit was a 390pF mica coupling capacitor which I had met up with or heard about on a previous occasion as a possible source of trouble in this brand of receiver.

It was only a few moment's work to unsolder it and clip it across the RC bridge. It read 270pF. No, wait a minute, it read 390pF. Then it seemed to waver between the two values, as if the clip connections from the bridge were poor. But they weren't and the bridge indicator eye simply went on flickering. No wonder the horizontal oscillator had been struggling to hold sync. with a key component intermittent internally. A new 390pF plastic tubular really cleared up the trouble, once and for all.

So, for the purpose of this article, I had to revise my previous "neat" explanations:

The basic trouble all along had been an intermittent 390pF mica capacitor. The early fiddling with the horizontal pot and hold coil had been in a futile effort to adapt to the changing value of the unstable capacitor. Sometimes the AFC managed to hold the picture stable, sometimes it didn't.

When I cleaned up the sockets and, later, changed over to germanium diodes, I improved the efficiency of the circuit and the ability of the AFC to cope with the basic problem. But the basic problem was still there, and I had acted out a classic case of alleviating the symptoms, without curing the disease!

Had I picked on the faulty capacitor in the first instance, the set would probably have operated normally thereafter, dirty valve sockets and selenium rectifiers notwithstanding. But it didn't happen that way for me or any of my predecessors.

What intrigued me about the whole situation, and the reason why I have so detailed it, was its potential for misunderstanding and ill will.

The simple fact is that if I—or any other serviceman—had encountered the set in the field in the ordinary way, we might logically have suspected the sync valve function and either replaced it or treated it for pin contamination. To all appearances, the trouble would have been rectified and we would have taken our leave—and the customer's money—not knowing that we had merely corrected a minor, aggravating condition.

If there had been a call back, we could logically have gone through my second procedure and again been unaware that the maladjustment was yet another aggravating condition. After all, it took a couple of days for this to become evident in my own living room and ser-

(Continued on p. 107)

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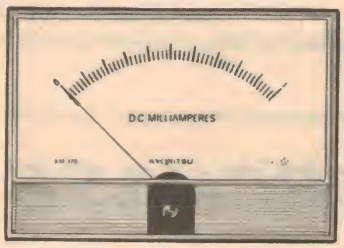

Moving Coil Type
DC Ammeters/Voltmeters
Range: 50 μA ~ 500 μA 1 mA ~ 500 mA
1 A ~ 100 A 3 V ~ 1000 V
Rectifier Type
AC Ammeter/Voltmeter
Range: 50 μA ~ 500 μA 1 mA ~ 10 mA
15 V ~ 1000 V
Moving Iron Type
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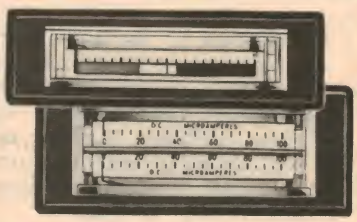

Moving Coil Type
DC Ammeter/Voltmeter
Range: 50 μA ~ 500 μA
1 mA ~ 500 mA 1 A ~ 100 A
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Low-cost electronic dice

The Electronics Australia—Kitsets Competition produced no less than four designs for electronic dice—with varying degrees of complexity and refinement. While some of the others may warrant publication later, we have given this one first choice because of its relative simplicity and low cost.

by J. L. STAPLETON*

Some time ago the author felt the need for a dice that could not cause disputes by rolling against an object, standing on its edge, and displaying two numbers. The device to be described meets this requirement and would also be suitable as a basic educational project.

The circuit consists of a binary counter followed by a BCD (Binary Coded Decimal) to 7 segment decoder/driver which, in turn, drives a 7 segment LED display. The counter is connected to a clock source by a push button switch. (S1).

Clock pulses are fed to the clock input of flip-flop 1 (FF1) which causes it to toggle. Its Q output is fed to the clock input of FF2, which toggles at half the clock speed. The Q terminal of FF2 connects to the clock input of FF3, which toggles at a quarter of the clock speed. This is a simple binary counter which would normally count from 0 to 7 (000 to 111 on the Q outputs) were it not for a circuit modification to be described shortly.

The SN7476 flip-flops were chosen for this design as they can be set for either a 0 or 1 on the Q terminal (with the Q bar terminal being 1 or 0 respectively). A low input on the S bar terminal causes the Q to go to 1 and the Q bar to 0. A low input on the R bar terminal causes the Q to go to 0 and Q bar to 1.

(Editorial note: In the event that the SN7476 is in short supply it would be possible to substitute an SN7473. To do this treat the R bar terminal on the 7473 as S bar, and the Q bar terminal as Q.)

As we want the counter to count from 1 to 6, we do not want a count of 0 or 7. This is overcome as follows: A count of 7 corresponds to 111, which means that each of the three Q terminals are high. These terminals are connected to a NAND gate (terminals 9, 10, 11, SN7410) as well as to the SN7447 decoder/driver.

When the NAND receives a 1 on each of its three inputs its output goes to 0 or low. This low output resets FF1 to 1 via the S bar terminal, and FF2 and FF3 to 0 via their R bar terminals. Thus, after reaching a count of 6 (110) the counter resets to 1 (001) on the next clock pulse.

The output from the flip-flops go to an SN7447 IC, which is the BCD to 7 segment decoder/driver. This, in turn, is connected via current limiting resistors to the 7 segment LED display, which has a common anode. Thus we have a circuit which counts from 1 to 6, resets to 1, then counts to 6 again for as long as clock pulses are applied.

This means that when S1 is depressed, the counter counts at high speed and all the eye sees on the display is the figure 8. When the button is released the "dice is thrown" and a number appears on the display. No manipulation of the button can cause a wanted number to appear because of the very high speed of the counter.

The clock pulses are generated by a simple oscillator consisting of two NAND gates, being the remainder of the SN7410.

The author constructed the prototype on a small piece of matrix board, the holes in which lined up exactly with the IC pin spacing. Layout is not critical and can be left to the constructor to work out. The prototype was housed in a small plastic box with the display showing through a rectangular hole in the top. There is an on-off toggle switch and the push button for "throwing the dice".

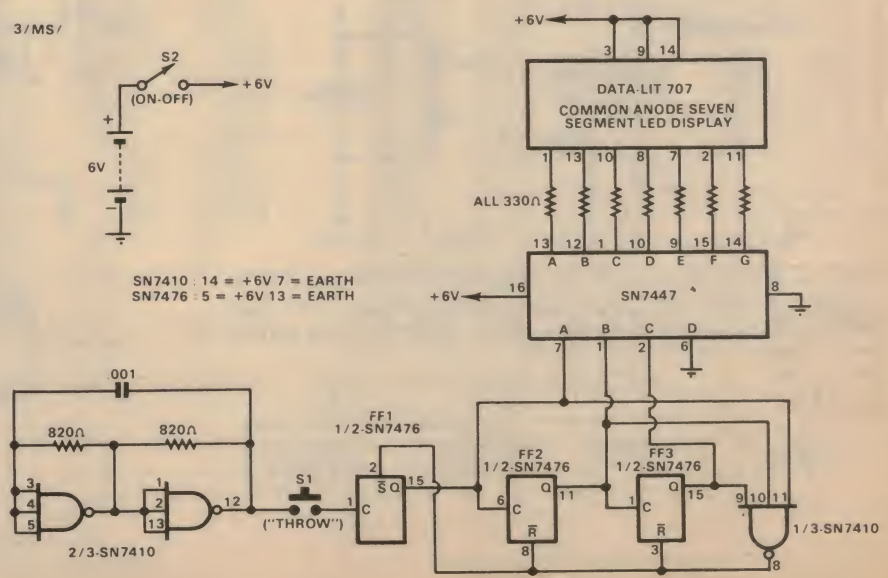
Four penlite cells were used to power the device and are conveniently accommodated in a readily available square holder. This gives a higher voltage (6) than the usual 5V rail used for these ICs but is less than the maximum figure of 7V.

The cost of all parts for the dice, including the plastic box and battery holder was just under $10.00.

PLEASE NOTE

This project is one contributed to our Kitsets-EA Competition. As such, it has not been through our laboratory and should not be regarded as a regular "Electronics Australia" project. We will therefore not be in a position to answer postal queries about its operation, or supply back-up information, diagrams, etc beyond what is published. And while we may quote the contributor's name and address, to authenticate the article, the contributor is under no obligation to answer letters about his project. That is entirely a matter of his own inclination and convenience.

Above: The dice is housed in a small plastic case. Below: The circuit diagram showing the essential simplicity of the design. When the button is pressed the counter runs at high speed. When it is released a number appears.



*33 Blamey St, Wagga Wagga, N.S.W. 2650

Additions to the automatic telephone exchange

The article in July 1974 describing an automatic telephone exchange aroused a lot of interest. Many have been built and are operating satisfactorily. However, some constructors have had trouble obtaining components and there have been enquiries regarding extension of the system and provision of extra facilities.

by GRAHAM LEADBEATER *

The author has had some 20 enquiries concerning the exchange, including letters, phone calls, and one enthusiast who called personally—with his exchange tucked under his arm!

At least two schools have undertaken the project. Kapunda High School, South Australia, has a system operating and North Sunshine Technical School, Victoria, is building one as a class project which will ultimately be used for communication within the school.

A letter from a New Zealand reader describes a nine line system which he built and which is operating on a farm in Pukerua Bay, Wellington.

Another unit has been built by a neighbour and installed on a large farm in Myrla, South Australia. It has proved a boon on the farm where communication between widely spaced buildings has always been a problem.

The biggest problem for many constructors has been to obtain the specified relays. Fortunately, these requirements are not critical and there are some circuit tricks which enable a wide range of types to be used.

The A relay: The coil configuration on this relay is important. The 200/200/570 ohm coil is very common in exchange circuitry. Its main requirement is that it have a high impedance at speech frequencies. This is achieved by using a core consisting of nickel-iron sleeves. Coils wound on such cores are identified by the marking "3N" stamped on the cheek.

Our A relay should employ such a core but need have only two windings, the tone being injected via a capacitor. (N. J. Diener, "EA" December, 1974.) There are also a lot of 50/50 ohm relays in existence and these may be used with a 150 ohm resistor in series with each coil. (Fig. 1.)

The B relay: Originally specified as 800 ohms with 1½in heel-end slug, its main requirement is a normal operate, slow release action. This can be achieved with almost any coil by connecting a capacitor in parallel with it (Fig. 2). The resistor is essential to limit the charging current and protect the A1 contacts.

The capacitance will depend on coil resistance and inductance, spring tension, residual air gap etc. A release time of about 300mS is required and, provided this is achieved, any resistance between 1000 and 5000 ohms will suit.

Alternatively, a diode in parallel with the coil may suffice.

The C relay: This relay must hold in while the uniselector is stepping. If a low resistance coil is not available refer "EA" December, 1974. Alternatively, strip the wire from an old coil and fill the winding space with 22 B&S wire. This should give a winding close to 5 ohms.

The D relay: The least critical of all. Any coil that will operate on 50V will do but, since it remains operated during a call, too low a resistance will overheat. Anything from 1000 to 10,000 ohms will suit.

The biggest problem was to provide sufficient contacts but the suggestion to use diodes (N. J. Diener, "EA"

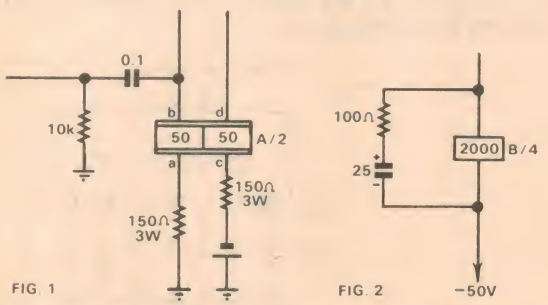
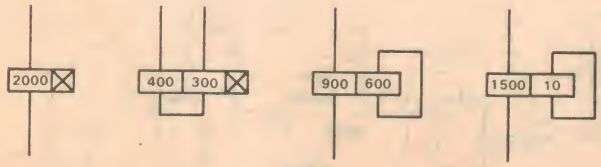


Fig 1. The A relay, previously a 200/200/570 ohm unit, may be replaced by a 50/50 ohm unit, as shown. Fig 2. Time delay network for alternative B relays. Fig 3. (below). How various types may be used for the LR relay.



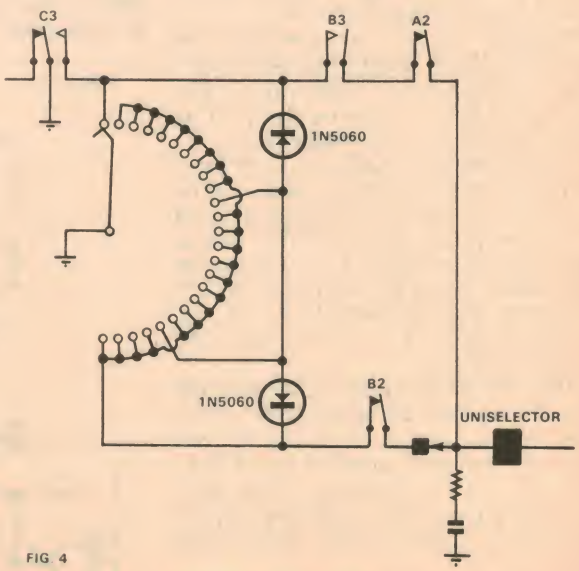


Fig 4. The number of lines which the exchange will handle can be increased by modifying the "home run" contact arrangement of the uniselector, as shown. (See Fig 5.)

16 Ellison St, Ringwood, Victoria, 3134

December, 1974) reduces the contact requirement to one break set and one changeover set.

The LR relay: Coil resistance can vary between 500 and 2000 ohms. If the available slug is longer than ½in it should still suit. A short circuited winding is as good as a slug in most cases. Thus, a coil with two windings may be used, one between 500 and 2000 ohms and the other short circuited. All LRs need not be the same. (Fig. 3.)

In many cases it may be possible to omit the 1uF and 56 ohm combination across LR. Try the system without these networks initially. If the ring is weak or LR buzzes with ring signal on any line, connect the network across that relay.

The E & F relays: These are non-critical. The value of 2000 ohms is only a guide, but is close to the minimum value. The higher the resistance the less capacitance needed to achieve a satisfactory on/off ratio.

Cradle relays: Using the preceding information, cradle relays may be employed for relays B, C, D, E, and F. They are not suitable for relays A or LR.

One of the most consistent requests concerns increasing the number of lines which the exchange will handle. This is done by modifying the "home run" contact arrangement of the uniselector. Instead of using the continuous contact fitted to some uniselectors for this function (refer circuit, July 1974, p77) a spare set of contacts are strapped as shown (Fig. 4).

This provides a "parking" position at 0 (10 impulses) and 00 (20 impulses) to permit dialling additional impulses. The lines will number 1 to 9, 01 to 09, and 001 to 004. Fig. 5 shows how the ring bank and tone bank of the uniselector are connected.

A very useful facility which can be added to this exchange is control of selected appliances from any phone. Fig. 6 shows the arrangement. One number is used for "switch on" and another for "switch off". No LR relays are required, relay RCA being the main component.

Within the exchange proper, contact C3 must be altered to a changeover set, while the uniselector needs to have a spare bank of contacts. Relay RCA is connected to the -50V supply rail via a 560 ohm resistor and to the appropriate contact on the extra uni bank. After this contact is dialled and C3 releases, the relay circuit is completed to chassis via C3. When RCA pulls in it locks up on its own contact RCA1.

When the "switch off" number is dialled the chassis connection via C3 short circuits the RCA coil and RCA releases.

The appliance is controlled by the second set of contacts, RCA2. If these are to control a mains operated appliance they must have adequate insulation and current rating. In most cases it will be both safer and more reliable to interpose a second relay designed for the switching involved.

A variation on the above is remote access to a public address system. A number is allocated for PA and, when dialled, connects the caller's phone into the PA. Fig. 7 shows the circuit.

As before, a relay (PA) is connected between the negative supply rail and chassis via a contact on the extra uniselector bank when the PA number is dialled. This switches on the PA amplifier. The input to the amplifier is wired to the equivalent contact on the tone bank of

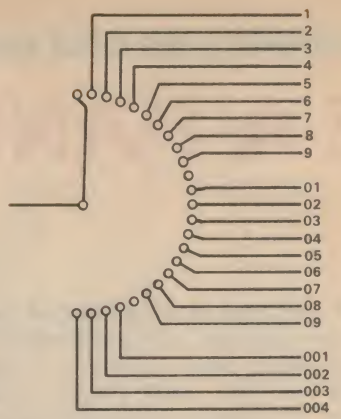


Fig. 5. The modifications necessary to the ring bank and tone bank of the uniselector to provide more lines.

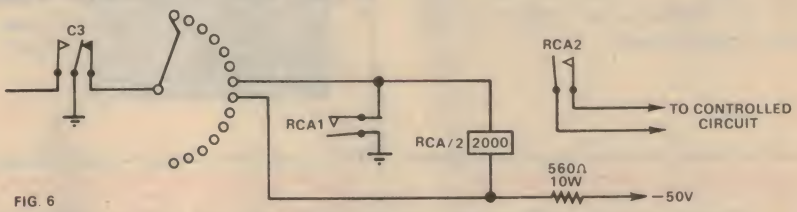


Fig. 6. Appliances may be controlled with this circuit. One number switches on and the relay locks up on its own contact. The second number switches off.

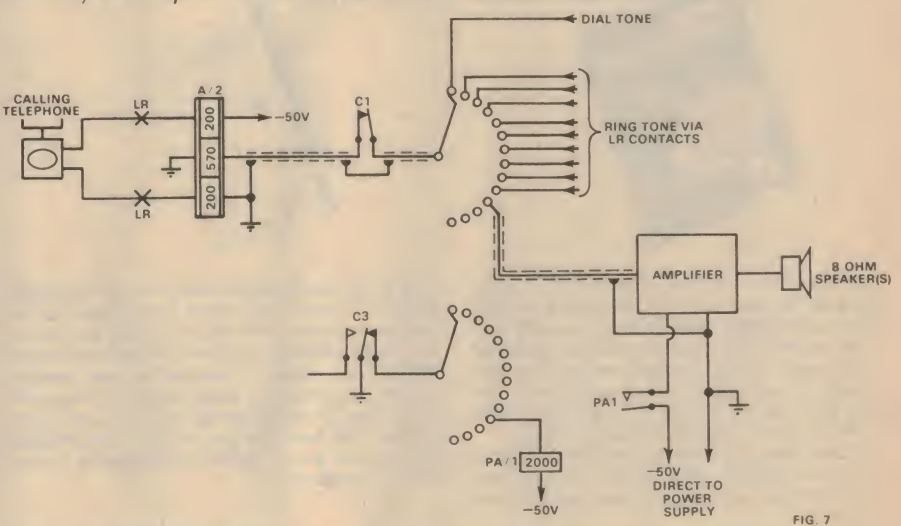
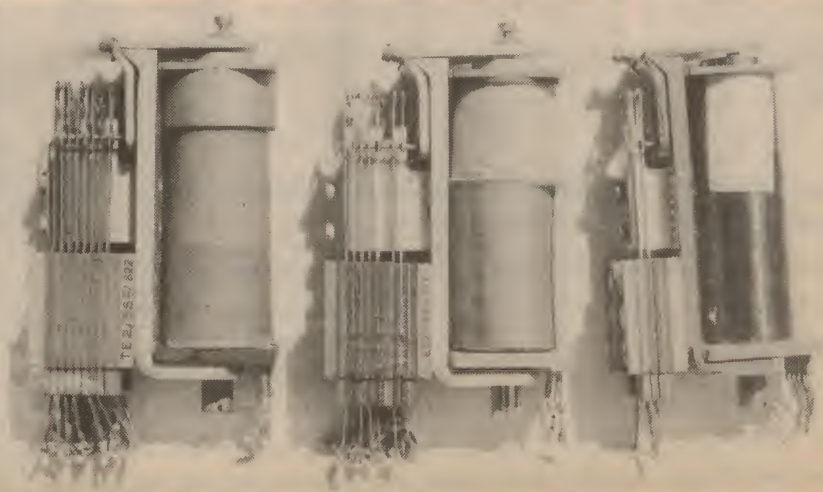


Fig. 7. Another very useful facility is direct dialling into a PA system. As shown, the lower bank switches on the amplifier and signal is fed in via the upper bank. If the amplifier can be left running, the lower circuit may be omitted.



At right: A selection of typical relays to assist recognition. Left: A ½in armature-end slug. Centre: A 1½in heel-end slug. Right, coil without slug and fixed residual air gap. Relay parts are normally interchangeable.

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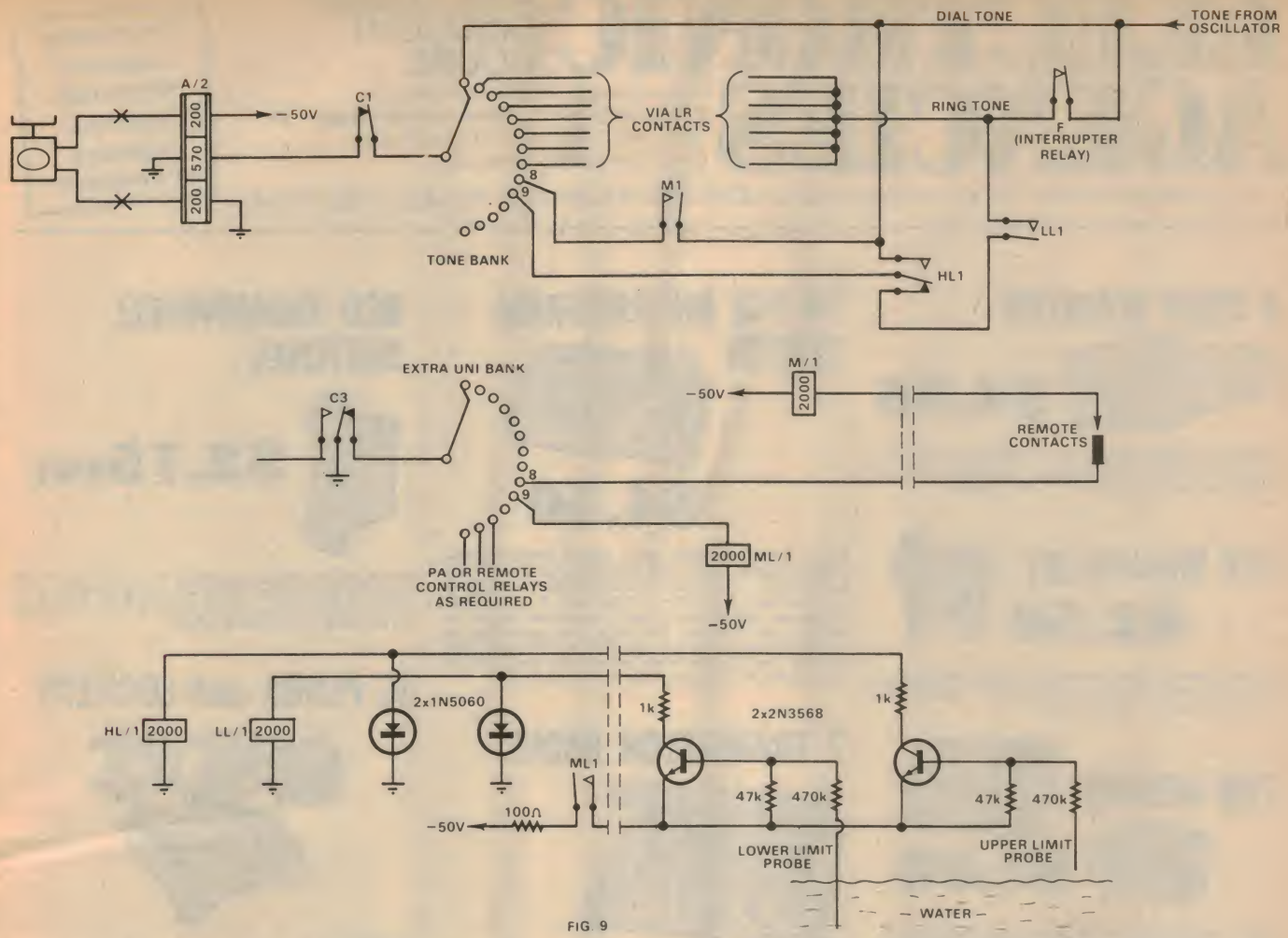

Fig. 9. Two alternative remote sensing arrangements. One (position 8) uses a local relay (M) to apply tone to position 8 on the tone bank. The other (position 9) uses three relays and can sense three remote conditions.

Fig. 8. Simple circuit for monitoring a distant sensor. Line capacitance may be a problem on long runs.

the uniselector and thence to the tone winding of the A relay. The circuit drops out when the handset is replaced.

If it is acceptable to leave the amplifier operating continuously, relay PA may be dispensed with and all that is needed is a signal lead from the tone bank to the amplifier input.

Signal level from the tone winding is about IV. Quality from a carbon microphone is not exactly high fidelity but adequate for most PA applications.

Another useful facility is a means to monitor a remote situation. On a farm, particularly, there are many situations which require regular surveillance, but which may involve travelling long distances in order to do this. With appropriate circuitry one can simply go to the nearest phone, dial a number, and determine whether a gate is closed, the level of water in a dam or tank, or even if there are any letters in the roadside mail box.

There is plenty of scope for ingenuity here. Circuits for sensing temperature, light, moisture, sound, etc, have all been described in the past. By connecting them into the system the required information is no further away than the nearest phone.

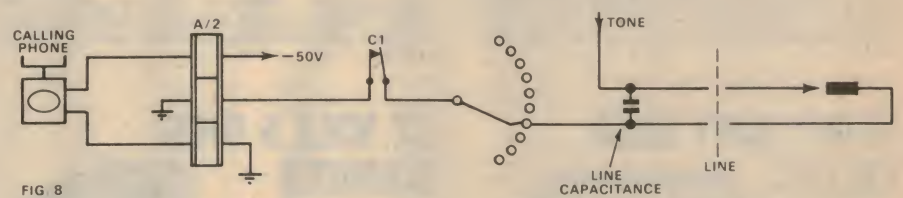

Figure 8 shows the simplest arrangement. An appropriate tone is simply connected to one side of the line, the other side of which is connected to the contact on the tone bank of the uniselector. At the remote point a contact operated by (say) a gate completes the circuit. Fig. 9 shows two such monitoring circuits. One, using position 8 of the uniselector bank, is an improved version of Fig. 8.

An objection to this arrangement is that line capacitance may cause enough tone to be heard, even with the contacts open, to make it difficult to discriminate between the open and closed states. Nevertheless, it is quite suitable for short distances.

A better method is to have the remote contacts operate a local relay in the tone circuit. Figure 9 shows two such monitoring circuits. One, using position 8 of the uniselector bank, is an improved version of Fig. 8.

This uses an extra uniselector bank, as for remote control and PA, to complete a relay circuit (relay M) when 8 is dialled. When the remote contact closes, relay M operates and contact M1 applies dial tone to position 8 on the tone bank.

The other monitoring circuit (position 9 on the uniselector) uses three relays (ML, HL, and LL), three wires to the remote point, plus an earth return, and can monitor three distinct conditions.

Dialling 9 will cause relay ML to operate and close contact ML1. This connects the emitter of each transistor to the negative supply rail, the collectors being connected to the positive chassis via HL and LL relay coils respectively.

With the water level below the lower limit probe, neither transistor will be forward biased and neither relay will operate. Thus, no tone means that the level is too low.

When the level rises to the lower probe the associated transistor is forward biased and relay LL operates. LL1

(Continued on p. 107)

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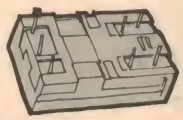
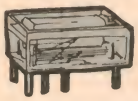
12V MINI-RELAY

$2.50

Amazingly small, yet highly reliable — features PCB mounting, with 2 amp single changeover contacts, 12V (nominal) 200 ohm coil. Size approx 22 x 15 x 18 mm.

PCB RELAYS





$2.00

Type A — super compact 2 changeover 2 pole relays, 500mA contacts, 48V coil 2.8K ohms, manufactured in Switzerland by ITT. Made for industrial and professional applications, these high grade relays now selling at ridiculously low prices. Buy 10 for $16.00. Size 29 x 15 x 12 mm.
Type B — high speed miniature 2 changeover 2 pole relay by Siemens, 48V 5K ohms coils, with dust-proof cover. Contacts will switch 250mA reliably — made for industrial and professional applications. Size 29 x 20 x 9 mm. Buy 10 for $16.00.

HEAVY DUTY REED RELAYS

$1.50

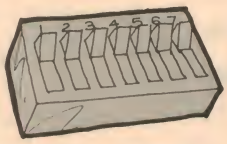
Ideal for burglar alarms, experimenting etc. Only 500 available at this price. The 50 mm long reed switch has SPST normally open contacts and is enclosed in a suitable coil of 6.5k ohms for 50V operation. The coil may be easily rewound for use on other voltages. An external protective cover is included. Size 68 x 18 x 20 mm. Buy 10 for $12.00.

2 POLE 110V MOTOR

This 2 pole, Australian made motor is similar to the type used in record players. The coil voltage is 110V AC at 30W, the drive shaft is 2 mm diameter x 37 mm long. Our rock-bottom price is below manufacturers cost. Sorry, but due to the weight (each 350gms or 12 ozs), these will only be sent freight collect.

Price	1-24	25-49	50+
	$1.50	$1.25	$1.00

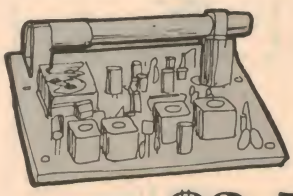
14 PIN DIL PROGRAM SWITCH



$4.50

When designing circuits which require small programe changes regularly, (eg. as in taxi-meters to allow for fare increases etc), it is obvious that a small multiple switch would be advantageous. These sub-miniature 7 pole single changeover switches are housed in a standard 14 pin DIL package and stand only 7 mm high. Each switch may be changed independently from the ON to the OFF state. High reliability long-life gold plated contacts are used, and the switch is dust resistant. Only limited number available.

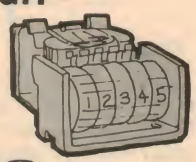
7 TRANSISTOR RADIO



$3.50ea

Fully assembled — ready to use. Add only speaker and 6V battery. Output 0.25 watts, use as tuner, radio etc. Build in your own case. Parts alone worth over $5.00. Qty 10 for $30.00.

12 VOLT 5 DIGIT COUNTER



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Counts to 99,999, easy to read, size only 50 mm L x 30 mm W x 20 mm H, 90 ohm coil draws only 130mA, non-resettable, Aust. made. Qty 10 for $30.00.

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International Rectifier type 21PT60.
These bargain-priced heavy duty rectifiers are available for printed circuit or direct wiring and are of small dimensions in a modern plastic package.

QTY.	PRICE
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$2.75ea

Latest ultra-thin printed circuit switches, numbered 0-10, BCD output, single pole only, size 37 mm L x 29 mm H x 7 mm W. Stack together to make multiple banks. Qty 4 for $10.00, Qty 10 for $22.50, Qty 100 for $205.00.

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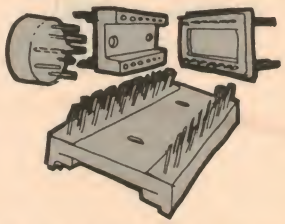

We offer a new range of 14 and 16 pin DIL plugs for standard 14 and 16 pin DIL sockets. Use as cheap connectors or for "programing" circuits or for plug-in mini modules — 100's of uses, now at low prices.

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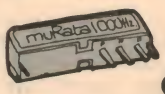
14 PIN DIL PLUG	0.40	0.36	0.33	0.30
16 PIN DIL PLUG	0.50	0.45	0.41	0.36
14 PIN DIL SOCKET	0.45	0.41	0.36	0.33
16 PIN DIL SOCKET	0.45	0.41	0.36	0.33
8 PIN DIL SOCKET	0.40	0.36	0.33	0.30
8 PIN TO5 SOCKET	0.65	0.60	0.56	0.52
10 PIN TO5 SOCKET	0.80	0.72	0.68	0.64

MURATA MICROFORK



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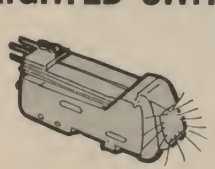
6V	MBC	0.24W	0.4A	25c
12V	MBC	1.2 W	0.1A	35c
12V	MES	1.2 W	0.1A	35c
24V	MBC	1.3 W	o.055A	40c
24V	MBC	3.5 W	0.145A	40c
24V	MES	1.3 W	0.055A	40c
24V	MES	2.8 W	0.11A	40c
28V	MES	3.1 W	0.11A	45c
50V	MBC	2.5 W	0.05A	50c
50V	MES	2.5 W	0.05A	50c
50V	MES	5 W	0.1A	50c
60V	MBC	3.5 W	0.06A	55c
60V	MES	3.5 W	0.06A	55c
48V	PO	1.4 W	0.03A	20c
50V	PO	1 W	0.02A	20c

MBC = Bayonet MES = Edison Screw PO = Post Office.

PLESSEY MINIATURE POTENTIOMETERS

Type Q pots are low-cost moulded track carbon potentiometers Ideal for applications where quality and small size are important. Size only 18 mm diam x 8 mm deep, not counting shaft size.
Range available — 40c ea
Linear — 100, 470, 500, 2.5k, 4.7k, 10k, 15k, 25k, 47k, 50k, 100k, 200k, 250k, 470k, 500k, 1M, 2M.
Log. — 1k, 2.5k, 5k, 47k, 50k, 100k, 250k, 1M.
Type PLW pots are precision miniature, sealed, pre-settable pots with screwdriver slot adjustment and collet for locking the shaft. Size only 12 mm diam x 10 mm deep, not counting shaft size.
Range available — $1.00 ea
Linear — 500, 1k, 5k, 15k.

LAMP-LIGHTED SWITCHES



Must be the cheapest illuminated press-key switches around. Made by Ericsson Telephones of England, they offer high reliability, long-life silver-plated contacts and various colored buttons. Lamp required is a Post Office No. 2 type.
Range available as locking or momentary action —
DPDT — 75c ea
4 PDT — 85c ea
6 PDT — $1.00 ea

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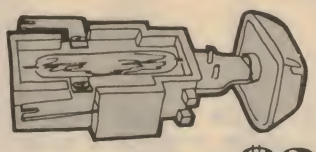

$2.50

This push-button, spring return switch features high reliability and minimum contact bounce due to single pole N/O reed switch actuated by magnet — as used in quality calculator keyboards. Handles 1 amp to 250V, size only 55 x 18 x 18 mm.

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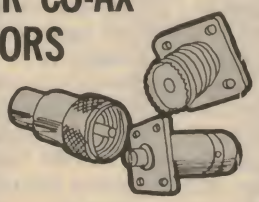
GREENPAR CO-AX CONNECTORS



From Britian's leading manufacturer of co-ax connectors, Greenpar Engineering Ltd, we offer a select range of popular BNC, UHF and series N connectors. Manufactured to military specifications, Greenpar connectors are made of fully machined brass with heat-treated beryllium copper contacts, silver-plated and Argalin passivated to prevent oxidisation.

P/N	EQUIV.	TYPE	PRICE
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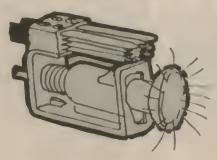
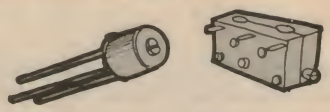
40008	UG175/U	UHF Reducing Adaptors	$0.20
40009	UG176/U	UHF Reducing Adaptors	$0.20
40029	S0239	UHF Socket (panel)	$1.00
40051	PL259	UHF Plug	$1.00
40006	PL258	UHF to UHF Adaptors	$1.00
35002	UG913/U	BNC Elbow plug	$1.50
35006	UG290/U	BNC Panel Socket	$1.00
35007	UG290A/U	BNC Panel Socket	$1.00
15003	UG594/U	"N" Elbow Plug 50 ohm	$1.70
15007	UG58A/U	"N" (Panel Socket)	$1.00
15015	UG21D/U	"N" Plug	$1.00
15022	UG23D/U	"N" Line Socket	$1.00
15032	UG160D/U	"N" Bulkhead Panel Skt	$1.00

ILLUMINATED PUSH-BUTTON SWITCHES



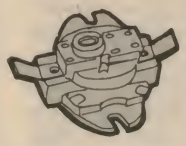
Popular series, as used by PMG — made by TMC Australia. Lamp required is a Post Office No. 2 type. High reliability and long life are key features. Asst. lens colors available.
DPDT = $1.50, 4PDT = $1.75, 6 PDT = $2.00.

PAINTON MINIATURE POTENTIOMETERS



These specialist type 412P cermet trim-pots are manufactured up to military specifications and feature precise adjustment and long life — they are completely sealed to keep out dust. Size 6 mm diam x 6 mm high, PCB mtg
Range available — 50c ea
Linear — 1k, 2.2k, 10k, 100k.
Multi-turn cermet trimmers, type PC, offer similar features to those above together with the fine adjustment possible with the multi-turn action.
Range available — $1.00 ea
Linear — 10, 20, 25, 50, 100, 200, 1k, 5k, 20k, 25k.

THERMO-DISK SWITCH

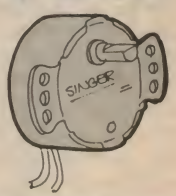


Don't risk burn-out caused by overheating. These clever (patented) switches may be mounted to heatsinks, transformers, motors or other devices which generate heat. At approx 40°C the switch turns off, and can be reset when cool again. Contacts will handle up to 250 VAC at 5 amps. We have approx 700 to clear!

Price	1-9	10-24	25-99	100+
	$1.50	$1.35	$1.20	$1.00

COMPACT 1 RPM MOTOR

$1.95



Manufactured by Singer Controls of USA, this compact motor/gearbox operates nominally from 115V AC 3W but may be operated directly from 240V AC with a 0.39 mfd 630V capacitor or 39K 5W resistor without loss of performance.

Price	1-9	10-24	25-99	100+
	$1.95	$1.75	$1.60	$1.40

BONANZA JACKPOT!

$25 value for only $5.
For experimenters and constructors, a large assortment of new, highest quality electronic components — samples, specials, end-of-line components including semiconductors, etc. This is real anti-inflationary VALUE FOR YOUR MONEY!

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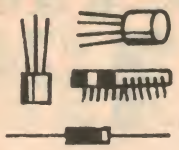


What's new in Solid State

Watch out—MTL is coming!

When the first crude integrated circuits made their debut around 12 years ago, they were based heavily on bipolar transistors. In the digital area, the first devices used RTL or resistor-transistor logic. Then came DTL or diode-transistor logic, ECL or emitter-coupled logic and TTL or transistor-transistor logic, all based on the use of bipolar transistors.

Bipolar transistors seemed well suited to digital circuit integration, and looked like becoming the established technology. The only area for discussion seemed to be the various types of circuitry, which had different advantages in terms of speed, power consumption, noise immunity and ease of fabrication.

TTL technology in particular gained very wide acceptance throughout the world, and the family of medium-scale or MSI devices grew from the mid 1960's to reach a very impressive level of development. However as time passed, it became apparent that TTL had reached something of an impasse; its power/speed performance was not good enough to permit the logical development into large-scale integration or LSI.

Naturally enough the semiconductor makers committed to TTL tried various ways of getting around the problem. They jacked up the speed with Schottky junctions, lowered the current levels to reduce power dissipation, and more recently combined the two ideas to give "low-power Schottky" TTL.

But meanwhile, MOS technology had been becoming more and more of a contender in the digital LSI arena. Around 1967 P-channel MOS LSI devices started to appear, then N-channel shortly after. And around 1970, complementary or CMOS appeared. This offered only modest operating speed, but combined with such a low operating power dissipaton that the power-speed figure turned out to be very much better than TTL—around 3 picojoules per gate.

What this meant in practical terms was that CMOS provided the way of squeezing more and more circuit elements into IC chips of practical size, and operating at a realistic power dissipation.

In view of these advantages over TTL and other bipolar approaches, it looked until quite recently that CMOS and the other MOS technologies were poised to eclipse bipolar as far as digital LSI is concerned. However, a new and quite different form of bipolar technology has been quietly gathering momentum from a slow beginning in 1971.

Known alternatively as I^2L, standing for "integrated injection logic", or MTL, standing for "merged transistor logic", the new bipolar technology now looks as if it will become the preferred LSI technology. Bipolar strikes back!

What's so different, and so good about the new technology? Almost everything. It is easier to make than either TTL or CMOS; its gates and other elements are between 4 and 10 times smaller than those of either TTL or CMOS; it has the speed of TTL, but uses less power than CMOS; and it will operate at supply voltages down to about 1V.

The small element size and fabrication ease of MTL are of course very important for LSI. The smaller the element size, the more elements can be squeezed on a chip. And the fewer the number of critical steps in fabrication, the lower the cost and the higher the yields.

MTL really scores here. It requires only two diffusions and 4 mask steps in fabrication, compared with 4 and 7 respectively for TTL and 3 and 6 respectively for CMOS. At the same time a basic gate requires only 5 square mils or .003 square mm, four times smaller than the most compact TTL gate, and 10 times smaller than a CMOS gate. This gives a packing density of no less than 200 gates per square mm!

Not only this, but the power dissipation of an MTL gate can be made as low as 6 nanowatts—less than one millionth that of a TTL gate—without unduly sacrificing speed. In fact MTL gates have been shown to have the lowest speed-power product of any technology yet found: the theoretical figure is .001 picojoule. MTL gates produced to date have had figures as low as 0.1pJ, very similar to a CMOS gate and comparing very well with the 100pJ of a TTL gate.

Currently developed MTL gates have delays as low as 10ns, basically the same as TTL. And they will operate at voltages down to 1V, like CMOS, whereas TTL cuts out at about 3V.

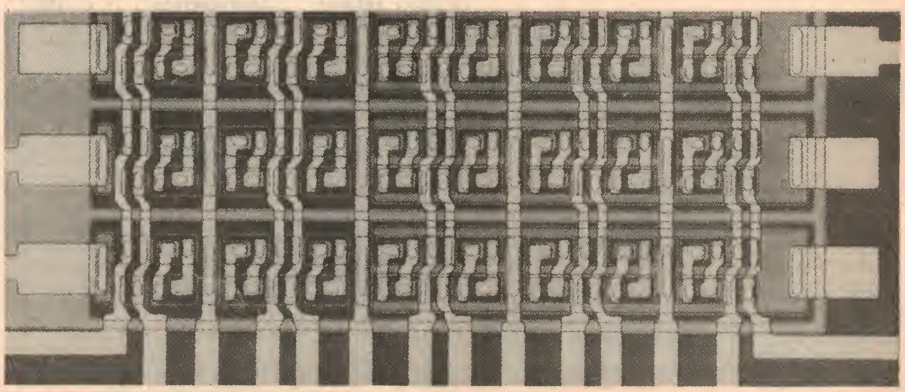
The basic MTL gate configuration is shown in Fig. 1, and as you can see it couldn't be much simpler. There are no passive components at all, just a NPN inverter transistor with multiple output collectors, whose base bias is supplied via a PNP transistor connected as a current source.

Note that the MTL gate has a single input and multiple outputs, the opposite of familiar TTL and CMOS gates, and the outputs are "open collector". This is because MTL uses wired or "dot" logic, as shown in Fig. 2. The positive-logic NOR operation is obtained by tying together outputs from two or more gates; if NAND is required, this can be obtained by using another gate as an inverter.

The bias current available at the input of each gate provides the "pull-up" current for the other gate output tied to it. This is a more economical approach than having pull-up resistors or transistors built in to each output, as unused outputs now draw no current. In addition, this approach makes MTL capable of directly driving TTL, and being driven directly from an open-collector TTL gate.

Part of the appeal of the basic MTL gate is that it needs no isolation "island" when built into an LSI chip. As shown in Fig. 3, it is self-isolating as well as being extremely simple.

The NPN inverter transistor uses the fairly conventional "vertical" structure, except that it is upside down—the mul-



A micrograph of portion of an experimental static RAM chip using the new MTL technology. Note the simple cell structure.

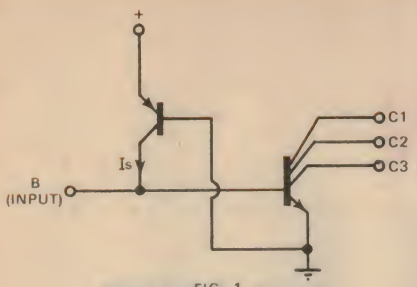
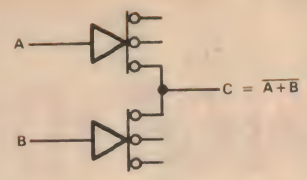


FIG. 1



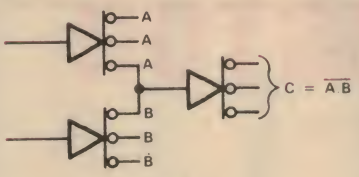


FIG. 2

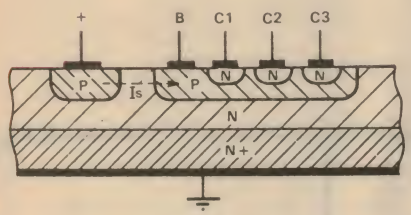


FIG. 3

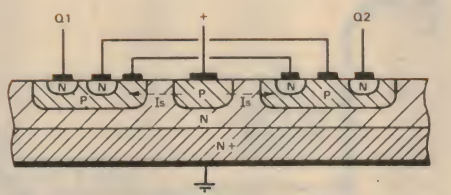
The basic MTL inverter gate and its structure are shown at left, with the ways of achieving NOR and NAND functions shown above.

tiple collectors are the small second-diffusion islands in the P-type base, whereas the earthed emitter is the N-type epitaxial layer and the substrate. The PNP biasing transistor is formed by the P-type base region, the adjacent P-type region connected to the positive supply, and the channel of N-type material between them—i.e., it is a "lateral" or horizontal transistor.

The structure needs no isolation, as the bulk of the N-type epitaxial layer surrounding it forms the inactive ground plane. Only the small channel between the two P-type regions plays any active role (as the base of the lateral PNP transistor), and this is automatically isolated.

Note that the PNP biasing transistor may be visualised as being purely a means of injecting carriers into the main P-type base region. Hence the name "integrated injection logic".

Fig. 4 shows a basic MTL flip-flop, as would be used in RAM memory cells. As you can see it uses a single P-type region connected to the positive supply, with each side serving as the emitter for the lateral PNP transistor injecting carriers into the two NPN transistor bases. The



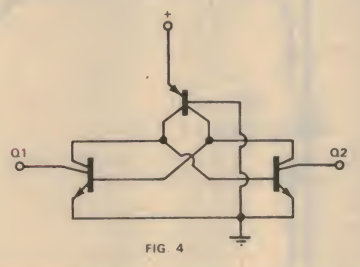


FIG. 4

complete flip-flop needs only two metalisation interconnections, and can be made very small indeed.

Although this has been a very brief look at MTL, I think you'll agree with me that it is very impressive. The implications of MTL for LSI technology are almost mind-boggling, so we'd better be prepared for some surprises! (J.R.)

Practical electronics demonstration:

THE UNIJUNCTION TRANSISTOR

by A. J. LOWE

This Teach Yourself Board demonstrates the operation of the unijunction transistor—a device of many uses, including that of providing the positive pulses needed to turn on silicon controlled rectifiers, as demonstrated in the previous Teach Yourself Board.

The layout of this board conforms to the usual pattern—working model in the top left corner, circuit diagram below it, and explanatory script on the right.

The circuit diagram is shown in Fig. 1 and it is set out in the same format as the wired model. The arrow heads show "conventional" current direction —positive to negative, rather than electron flow direction.

There are no real problems in construction, and perhaps the only item which needs some explanation is the speaker mounting. The speaker was a typical 8 ohm 50mm transistor radio speaker. It was mounted pointing upward in a plastic box which once held a roll of ½in Scotch sticky tape. The boss in the middle of the box very conveniently accommodates the magnet.

A hole was cut in the lid of the box and a piece of aluminium grill metal (ex old radio) fitted between the top of the speaker and the lid. The lower part of the box was screwed to the board. There is no need to follow this mounting technique but the details are mentioned as a suggestion.

The value of the resistor R2 should be selected so that with the capacitor and UJT used, the speaker clicks can be varied from about 5 per second up to a

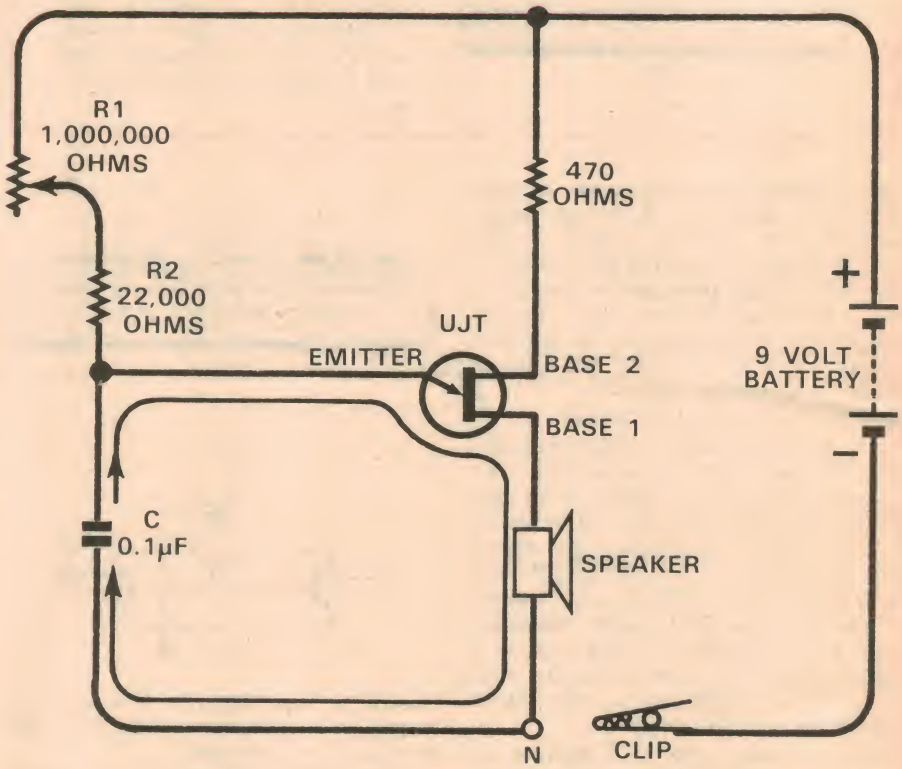
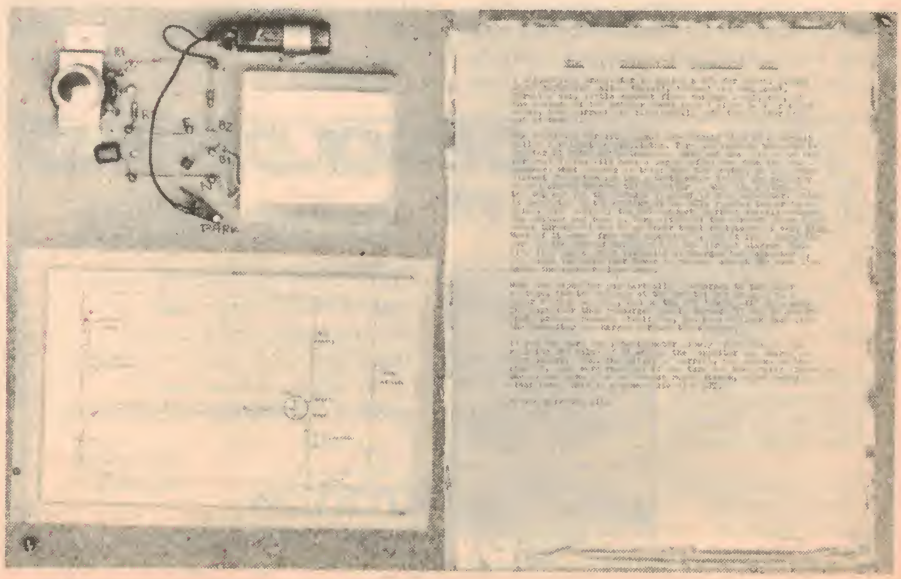


FIG. 1

PARTS LIST

PARTS LIST

1 megohnm potentiometer
1 22000 ohms resistor (see text) ¼ watt
1 470 ohms resistor ¼ watt
1 0.1uF capacitor
1 8 ohm small speaker
1 unijunction transistor H16L or UT46 or similar
1 9 volts battery
Battery clip, crocodile clip, aluminium, knob, box for speaker, etc.



WHAT A UNIJUNCTION DOES

A unijunction transistor is called a UJT for short. It has three terminals called "base 1", "base 2" and "emitter". Normally very little current flows through a UJT, but, if the voltage between the emitter and base 1 rises to a critical value, then current can flow readily into the emitter and out at base 1.

The model and circuit diagram demonstrate this in a circuit called a relaxation oscillator. Turn the knob on the potentiometer R1 fully anti-clockwise. Next put the clip on to the terminal N. You will hear a series of clicks from the loudspeaker. What happens is this: When the battery is connected current flows through the potentiometer R1 and the resistor R2 and slowly charges the capacitor C.

When the voltage at the top end (in the circuit diagram) of this capacitor, which is connected to the emitter of the UJT, reaches the critical value, the UJT conducts readily between the emitter and base 1. Very little of the current which flows comes through R1 and R2 as their total resistance is very high. Most of it comes from the capacitor C, and it flows round the part of the circuit indicated by the dashed line. This flow is a pulse which partially discharges the capacitor C, lowers the capacitor voltage and, at the same time, makes the speaker click once.

When the capacitor has partially discharged to the lower voltage, then the voltage at the emitter will have dropped to a lower voltage as well, and so the UJT "shuts off" once more. The capacitor then recharges slowly through R1 and R2 and the whole process repeats itself. So, you hear a click each time the capacitor discharges through the speaker.

The important point to grasp here is that, while the emitter will not conduct until its voltage has been raised to a certain value, once it does conduct it will continue to conduct until its voltage falls to a significantly lower value. It is the difference between these two voltage values which enables the unijunction to function as a relaxation oscillator. If you turn the potentiometer slowly clockwise you are reducing the value of R1 and so the capacitor can charge more quickly. Thus the pulses of current, and clicks in the speaker, come more rapidly. If you turn the knob fully clockwise the pulses come in a rapid stream, which makes a clear note. This is a common use for a UJT.

Please park the clip.

high but still audible rate which sounds like a musical note.

This device should not be expected to produce enough noise to be heard in the midst of a battle. It doesn't—but it is clearly audible in quiet surroundings.

The prototype used an NEC H16L unijunction transistor, but any of the readily available ones will do just as well. The UT46 costs 60c, but note that its emitter lead is in the centre—not on the outside as in the prototype.

After the main experiment, as detailed in the panel above, the following further experiments are suggested.

If an oscilloscope is available it is interesting to display the "shape" of the output pulses from base 1. Note that the pulses are positive going—as required to turn on an SCR. Study also the pulses from base 2 and from the top of the capacitor.

If you made the board in the previous lesson you can try turning on the SCR with a pulse from this UJT circuit; as follows:

(a) Join the negative of the SCR circuit to the negative of the UJT circuit. (b) Join the B1 terminal of the UJT to the gate terminal of the SCR. (c) Connect the SCR battery but don't push the button. (d) Turn the UJT pot fully anti-clockwise for slowest rate pulses. (e) Connect the battery to the UJT circuit. With any luck the lamp will light at the first click.

Now connect a 4.7uF (tantalum) capacitor in parallel with the 0.1uF capacitor on the board; the positive terminal connected to the lower end of R2. Adjust the pot so that the clicks are several seconds apart.

It will now take several seconds before the lamp turns on. You have built a time delay circuit!

Our next lesson will describe a board to demonstrate what a field effect transistor does.

Classical Recordings

Reviewed by Julian Russell

Stravinsky—The Firebird: disappointing

STRAVINSKY—The Firebird. Complete Ballet. London Philharmonic Orchestra conducted by Bernard Haitink. Philips Stereo 6500 483.

This is the original version in which Stravinsky used what he later described, after revising the score, as a wastefully large orchestra. It was, however, the first version I heard under Ansermet just after World War 1, and I have never lost my affection for it. But much as I admire Haitink, I am not altogether happy with his account of it here.

There is nothing wrong with the way he starts—an ultra pianissimo so quiet the ears must be strained to hear it. This provides just the right atmosphere of mystery, interrupted by the glitter of the Firebird's brief appearance as she flutters across the stage. But I didn't enjoy at all the passage a little later where Ivan captures the Firebird. The playing here is a little too matter-of-fact. The detail is splendid but some of it a little too prosaic for this romantic early work. At the time of Firebird's composition, the "cool" Stravinsky of the neo-classical period was more than a decade away.

By the way this original version has always the same orchestral balance as the better known revision. Some of Haitink's tempos in the first part are a bit on the slow side, as he would be quick to learn if he had a stage ballet to accompany in the theatre. And when the princesses appear there is no attempt to preserve the mystery of the prelude.

Haitink picks up beautifully in the Dance of the Golden Apples. This episode has rather a curious history that I cannot recall having seen on any record sleeve of the ballet. Stravinsky was never satisfied with it. He rewrote it several times during his long life but said exasperatedly that he could never rid it of its "Mendelssohnian" atmosphere. I know exactly what he meant but still cannot agree with him. The episode is, to me, still one of the most beautifully wrought delicate interludes in all his work. Haitink takes it a little faster than dancers would like it played to dance to.

There is not very much dance atmosphere in the Princesses' Rondo which Haitink succeeds in making sound almost lugubrious. It is one of the rare occasions where Haitink really disappoints me hopelessly because I cannot understand just what he is after. Keen eared listeners will notice much difference between the original Koschei music, as played here, and the revised version. Haitink gets a really grand climax, though this, too, goes a trifle too fast for dancers' comfort. It all ends in a fine blaze of colour but I cannot recommend the production with any great enthusiasm.

★ ★ ★

BEETHOVEN—Concerto for Violin and Orchestra in D Major. Arthur Grumiaux (violin) and the Concertgebouw Orchestra of Amsterdam conducted by Colin Davis. Philips Stereo 6500 775.

I have long admired the thoughtfulness that underlies everything I have heard Arthur Grumiaux play. I remember well his seraphic recording of some Beethoven Violin Sonatas that was issued so many years ago that it must now, I think, have been deleted from the current catalogue. Grumiaux brings the same impeccable musicianship to bear on his new performance of this concerto with the added benefit of a splendid accompaniment most admirably recorded with great depth and fine tone. In mentioning Grumiaux' superb musicianship, I do not wish to hint that this tends to make him hide his very great virtuosity. On the contrary, this is evident whenever it can be suitably introduced. He has chosen, I think for this reason, the Kreisler cadenza which comes off with great elan, followed by some quiet playing so delicious that it tempted me to repeat it without even waiting for the end of the movement.

The Concertgebouw Orchestra gives Colin Davis all that it has got—which is considerable. And Davis partners Grumiaux to perfection. As I wrote earlier the sound is really great. This concerto has many tough competitors in recorded form, one or more of which you may already own. But if you're looking for a new one played with impeccable credentials, this should be it.

RACHMANINOFF—Piano Concerto No. 1 in F Sharp Minor. Piano Concerto No. 4 in G Minor. Rafael Orozco (piano) with the Royal Philharmonic Orchestra conducted by Edo de Waart. Philips Stereo 6500 541.

The sound on this disc is excellent if one forgets the momentary reverberation at the beginning of the first movement of the First Concerto. Orozco at the piano takes this movement at breakneck speed without ever seeming to extend his quite extraordinary fleet technique. And both he and the conductor are careful never to drool sentimentally over the juicy passages in the second subject. Indeed both pianist and orchestra never fail to do just the right things at the right time.

The orchestra under Edo de Waart reflects the soloist's every mood and plays with splendid tone. I enjoyed Orozco's poetic solo at the beginning of the slow movement enormously and felt that I could almost warm my hands at some of de Waart's romantic phrasing of the orchestral part. In the Finale soloist and orchestra resume the racing speed of the first movement and bring the concerto to an exciting conclusion.

The Fourth Concerto is given a very spirited, sparkling opening and later Orozco charms with some very beautiful rippling figurations, every note articulated with faultless clarity. In this work you have again a restrained poetic opening to the Largo, followed by a Finale which is brilliant without glare. The engineer has caught to perfection the many subtle changes of sonorities in both the piano and orchestral parts. If you want to get away from too solemn a reading of these two fine concertos this disc is certainly for you.

Cassettes

BEETHOVEN—Symphony No. 5 in C Minor. Vienna Philharmonic Orchestra conducted by Carlos Kleiber. DGG Stereo Dolby Cassette 330 472. Disc No. DGG 2530 516.

Many years ago, the late Neville Cardus said to me after a concert featuring this work: "What on earth can anyone say nowadays about the Fifth?" Then he added with a grin: "Except that it is still in C Minor." Well here is a new recording that should encourage excited comment wherever it is played. For even I who have heard the symphony in varying circumstances—live and recorded—many more times than I can even begin to remember—got a thrill from this version from the brilliant son of a famous father. This is no place to enlarge on what has been said since it was first composed—the unrelenting defiance of the first movement, the lyricism of the second, the mystery of the third and the triumphant glory of the finale. All these are features already more than well known to anyone with a genuine interest in music.

Every good conductor has, of course, his own ideas about how it should go but all with any claim to merit respect the general layout of, and the thought behind, the composer's music. But here is a reading that is superlative in every way. The Vienna Philharmonic is at its glorious best both tonally and accurately with all, repeat all, that this implies. Beethoven's markings are scrupulously observed.

The engineering has a very wide dynamic range which never becomes oppressive at its loudest in a decent sized music room. From the first note to the last the listener has the unusual feeling that nothing can possibly go wrong. And nothing does. The tension always remains as taut as a piano string. And on top of all its other merits, young Kleiber imbues it with continuing elegance and freshness of approach that gives this old warrior a new life. I will even go so far as to say that I felt that I was hearing it for the first time—an achievement of monumental skill and musicianship on the part of the performers.

I don't care which version or versions of this symphony you might already have. Here is one nobody, in my opinion, can afford to be without. I think the evidence points to the young Kleiber having carefully studied the very fine performance by his father, Erich, many, many years ago and was inspired by it to contribute something of himself to a performance that left little room for improvement. And he has found details to bring out that never occurred to the older man—especially rhythmical ones—that glorify every bar. I cannot add anything more to my recommendation without descending into schoolgirl gush.

★ ★ ★

RACHMANINOFF—Piano Concerto No. 3 in D Minor. Rafael Orozco (piano) with the Royal Philharmonic Orchestra conducted by Edo de Warr. Piano Prelude in C Sharp Minor. Rafael Orozco (piano). Philips Stereo (non Dolby) Cassette 7300 203. Disc 6500 540.

I had an unusual experience when I first played this cassette. I hadn't noticed that it was not Dolbyised and consequently had the Dolby switch in the "on" position on my cassette player. The result was that the piano figurations in the first movement emerged so very forward that they completely overlaid the orchestral part. When I switched the Dolby attachment off the sound was much improved, though not quite up to Dolby standards. I don't mean by this that the old pre-Dolby bogey of tape hiss was at all noticeable in this cassette, except very occasionally in a slight bar. Otherwise it is eminently acceptable, though you may notice an occasional wavering of balance between orchestra and pianist. I think that on the whole you'll do better with some of the very good disc versions of this always popular concerto.

The sound is a bit better on the reverse track which starts with the Intermezzo. And I could find no fault with the lovely fluttering interlude in the Finale. Orozco's playing is quite exquisite here and his technique all through irreproachable. I might mention that I was very disappointed with de Waat's playing of one slow introduction to one Intermezzo.

The first track opens, not with the first movement of the concerto but with an Orozco solo of the famous C Sharp Minor Prelude. You know the one! It has acquired a totally false program of representing the premature burial of a beautiful young bride. In dismissing this gaffe many years ago the famous English critic, Ernest Newman, said that if the story was true surely the first three notes were meant to say "Oh, my Gawd." Orozco carefully avoids any suggestion of melodrama in his reading of the piece and for this reason it is very good indeed.

★ ★ ★

BRAHMS—Piano Concerto No. 2 in B Flat. Alfred Brendel (piano) with the Concertgebouw Orchestra of Amsterdam conducted by Bernard Haitink. Hungarian Dances in G Minor and F Major played by the same artists. Philips Dolby Stereo Cassette 7399 293. Disc No. 6500 767.

There is no questioning the consistent beauty of Brendel's cassette version of the Brahms Second. And for reasons that I shall explain later it is Brendel's skilful exploitation of his tone that is the outstanding feature of the performance. Indeed his playing comes so close to perfection that I think it unnecessary to indulge here in the superlatives that it would deserve if I had more space at my disposal.

If you should wish to check my judgment on this feature I recommend that you play, as a sample, the long piano solo in the third movement which has, you may recall, one of the most beautiful piano entries in all the musical literature of piano and orchestra and which, by the way, occurs early in the movement. And if this doesn't quite convince you go on to the marvellous series of trills at the end.

There is, however, another feature of the Brendel-Haitink collaboration that caused me some uneasiness during the entire work, despite Brendel's immaculate performance. It is that there doesn't seem to be the same complete rapport between conductor and soloist as you will find in the Brendel/Schmidt-Isserstedt Brahms First, as mentioned in the record section of this month's column. Not that either is ever at serious odds with the other but there are several occasions when one has a disturbing feeling that it is not a perfect partnership.

Also the balance between soloist and orchestra is not always as satisfactory as it might be. I think this is caused by Brendel's part being recorded rather forwardly in terms of the orchestra. For instance there is one important passage where the horn enters solo against beautiful piano figurations, and here the horn sounds much too distant to win the best possible effect. This is one of the few times where what I can only describe as open conflict occurs between pianist and orchestra.

All this might not be so in the disc version of the work which I have not heard, though the sound is so good on the cassette that I find it difficult to imagine much difference. And on the cassette—I am not sure about the disc—you have a bonus in the form of two of Brahms' popular Hungarian Dances, one in G Minor, the other in F Major. The first is attractively spirited, the second alluringly graceful, though in the latter the horns, once again, sound unnecessarily muffled in terms of balance. The oboe, however, gets through deliciously.

If you are thinking of trying an alternative version of the Brahms Second I can enthusiastically recommend the Serkin/Szell performance. In it you will notice several differences of interpretation which I think would, so far as I'm concerned, tip the balance in favour of the competitor. There are, however, several other recordings that you may well consider worthy of comparison too.

Lighter Side

Reviews of other recordings

Devotional Records

CHRISTMAS NOW AND THEN. Matthew Green's Orchestral Rainbow. Stereo M7, MFLA-084.

The problem faced by anyone aspiring to issue a Christmas record is how to make it different from any number of such records that have been issued through the years. Matthew Green's formula is to provide continuity of a kind by threading snatches of the Scrooge story between titles. Recounted ostensibly by a young lad in a cockney accent, Australian listeners will find it none too easy to follow. The music itself is a mixture of conventional choral and instrumental with rhythm and amplified guitars:

We Three Kings – Hark The Herald Angels – The First Noel – Away In A Manger – Once In Royal David's City – The Holly and The Ivy – Silent Night – Good King Wenceslas – Angels From The Realms of Glory – O Come All Ye Faithful – God Rest Ye Merry Gentlemen – While Shepherds Watched Their Flocks By Night.

Matthew Green has set out to be different and he has certainly succeeded but whether you'll appreciate the result is another matter. Personally, I doubt whether I'll want to listen to it again! (W N.W.)

★ ★ ★

DIDN'T HE SHINE. Dallas Holm. Stereo, Pilgrim JLPS-196. (From S. John Bacon Publishing, 12-13 Windsor Ave., Mt Waverley, Vic. 3149).

The jacket notes give no background to Dallas Holm or to the members of the "Joshua" instrumental group which backs him. However, the recording was made at Nashville Tennessee and dedicated to former drug addicts at Teen Challenge, Brooklyn.

Whatever that signifies, Dallas Holm is a very capable singer straight out of the pop scene, remarks that apply equally to the backing group. The difference is that all the tracks have devotional titles and a devotional objective:

Let My Light Shine – The Secret – The Blood Will Never Lose Its Power – Oh, I Need Him – Didn't He Shine – Get All Excited – Song Of The Sinner – The Solid Rock – No Good Thing Have I Done – I Should Have Been Crucified.

Listening to the tracks, my strictly non-teenage ears kept hearing Elvis Presley so I guess that, if your musical tastes peak in the Presley-to-'75 era, this will be your meat. (W.N.W.)

★ ★ ★

LISTEN ... HE'S HERE. The Children of Light. Stereo, Milk & Honey MH1001. (From S. John Bacon Publishing Co, 12-13 Windsor Avenue, Mt Waverley, Vic 3149.)

Teamed with producer Bob Kragstad, well known Gospel musician Don Wyrtzen has come up with this modern and pleasant album, featuring a small vocal group backed by instrumental ranging from solo piano to a full orchestra. The actual numbers are all new to me but their devotional character is clearly indicated by the titles:

Let Me Introduce You – The Lord Is My Shepherd – Jesus Took My Sins Away – Written In The Book Of Love – Praise Him In The Morning – Yesterday, Today and Tomorrow – Hallelujah Yes Praise The Lord – Speak Softly – Brand New Day – Alleluia – Come Let Us Sing To The Lord – Trust In The Lord.

The arrangements are varied, modern but always tuneful, pleasant to listen to and of potential interest to church groups on the lookout for additions of their repertoire. The jacket notes mention that a score is available, as well as a music-only accompaniment tape. My one reservation: a slight edginess on the female voices. (W.N.W.)

★ ★ ★

HIS PROMISE OF LOVE. Telaman Singers. ART stereo AST-508. (From Advent Radio Television Productions, 150 Fox Valley Road, Wahroongah 2076. $5.95 post free or through local record shops.)

Producer Brian Keitley brought this new album to me personally with the idea that E.A. might be able to bring it to the notice of more people interested in its contents.

The Telaman Singers is a group of eight young people, based in Sydney and presumably attached to the Advent Church. Their music, predominantly vocal, features several of their own arrangements. It is drawn from a variety of sources, contemporary and traditional, while two of the tracks owe their origin to none other than J. S. Bach: His Promise Of Love – All People Sing Thy Praises – A Quiet Place – Theme From Wayout – He's Listening – Valley Of Despair – Talk To The Lord About It – Fugue In E-flat – There Came A Man – Poor Wayfaring Stranger –A Better Life – Now Walk With God.

With instrumental support directed by Laurie Lewis, the group produces a gently rhythmic and tuneful sound, easy on the ear, and exhibiting a truly professional approach.

Recorded originally in the EMI studios, the general balance and quality is about average. (W.N.W.)

Instrumental, Vocal and Humour

HOORAY FOR HOLLYWOOD. The Golden Age Of The Hollywood Musical. United Artists L-35420.

I'm reasonably interested in old movies and, as a youth, I had quite a crush on Bebe Daniels but I'm afraid my sense of nostalgia wasn't equal to this one. By today's standards, the stars sound like anything but polished performers and their efforts aren't aided by a recording quality that's nowhere near as listenable as it might have been with a little more care.

Still, if you're determined to recapture some of the "golden age", this album will bring you soundtrack snippets from: Hollywood Hotel–Gold Diggers Of 1935 –42nd Street–In Caliente–Gold Diggers Of 1937–Wonder Bar–Fashions Of 1934 –And She Learned About Dames–Dames.

A brochure packed with the disc carries scenes from the films, identifies the stars and gives some background to the sound snippets but even this didn't do much for me. Sorry if I've put you off. (W.N.W.)

★ ★ ★

ROGER WILLIAMS, I Honestly Love You MCA MAPS 7575. Astor Release

Five of the tracks on this disc are TV and movie themes and, as a result, they get the full theatrical treatment from Roger Williams, with good effect. The themes are: The Young And The Restless – The Godfather Part II – Airport 75 – We May Never Love Like This Again (from The Towering Inferno) – Murder On The Orient Express. Other tracks include: I Honestly Love You – My Melody Of Love – On[illegible] You – Rainbow – Melody To Dawn.

Reviews in this section are by Neville Williams (W.N.W.). Harry Tyrer (H.A.T.), Leo Simpson (L.D.S.), Norman Marks (N.J.M.) and David Edwards (D.W.E.,.

Credit for the orchestrations is shared by Al Capps and Stephen Hartley Dorff. This would be a good addition to your collection of show themes if the music takes your fancy. (N.J.M.)

★ ★ ★

CONEY ISLAND. Herb Alpert And The TJB A&M Records. L 35440 Festival release.

Herb Alpert has cerainly changed his style since The Tijuana Brass first shot to the top of the charts a few years ago with their rather brash and brassy style of jazz. Alpert is less prominent than usual on this disc, there being more attention to the percussion side of things.

The titles are: Coney Island – I Have Dreamed – Senor Mouse Mickey – Sweet Georgia Brown – Ratatouille – Catfish – This Masquerade – Carmine – The Crave – Vento Bravo – I Belong.

It is hardly a disc for quiet background listening, but the TJB never intended their style of music for such use. The record is of A&M's usual high technical standard so, if you are an Alpert Fan, rush out and buy it. (N.J.M.)

★ ★ ★

GOOD MUSIC HITS VOL. 1. Festival Strings. Festival stereo L 25191.

"Easy listening with the Festival Strings" could just as easily have been the title of this album and that quite sums it up. Easy listening for driving or relaxing. Recording quality is good.

Twelve tracks are featured: Girls On The Avenue – Lovers Alias Fools – Cassandra – The Wheat In The Field – Take My Hand – The Lord's Prayer – Silvery Moon – Body & Soul – Way Out West – Leave Love Enough Alone – Amazing Grace – Je T'aime. (L.D.S.)

★ ★ ★

CHET ATKINS, The Most Popular Guitar. RCA Camden ACLI-0834.

If you expect a predominantly solo guitar on a record with a title like this, you may be a little disappointed—but not for long! It is one of the most enjoyable records of 'standards' I have heard for a long time. Chet Atkins has been responsible for a lot of the musical direction of RCA's recording enterprises and his musicianship shows on every track: It Ain't Necessarily So – My Dear Little Sweetheart – Stay As Sweet As You Are – Monte Carlo Melody – When Day Is Done – My Prayer – Rock-A-Bye Bay – Vanessa – Intermezzo – Hi-Lili, Hi-Lo – East Of The Sun – Goin' Home.

It is a pity the backing orchestra is not named, they do an excellent job. If you get a chance to hear the disc, listen to 'It Ain't Necessarily So' and 'Vanessa' and you will see what I mean. (N.J.M.)

★ ★ ★

STEEL RIDES. Lloyd Green. Monument L 35490. Festival Release.

Lloyd Green's main claim to fame seems to be that he helped Paul McCartney record "Sally G". At least, this is the impression I gained from the photo of Paul & Linda McCartney, and Lloyd, which is included on the album cover. Such things aside, Lloyd plays steel guitar and, aided by a number of other musicians, he has produced quite a listenable album.

As well as a cover version of "Sally G", and some old favourites, such as "San Antonio Rose", this album includes some compositions by Lloyd, to give a total of eleven tracks. While all the tracks are of a very high standard, I found that the McCartney one made the greatest impression.

My overall impression of the album is that it has a slight country flavour. I could not fault it technically, so it would be well worth investigating. (D.W.E.)

Vintage tunes . . .

BOBBY MACLEOD'S VINTAGE BLEND. Astor stereo GGS 1468.

Records of Scottish or Irish dance music are often of mediocre quality and uninspiring performance but I am happy to report that this album is an exception to that observation. If you have any rhythm at all you'll soon be tapping your toes to these lively tunes. If you like Scottish dance music then this a good buy. There are also some Irish tunes and reels mixed in.

Many tunes are featured, mostly in medley form: The Kilberry Ball – The Liberton Pipe Band – Wives Of The Glen – Judy's Reel – The Last House In Conaught – Loch Leven Castle – The Kyle Furlough – Loch Rannoch – Mrs MacDonald Of Dunach – When I Grow Too Old To Dream – Be Nobody's Darling But Mine – The Old Man's Fancy – The Athalone Jig. (L.D.S.)

IN CONCERT WITH CHARLEY PRIDE. Featuring Chet Atkins, Ronnie Milsap, Dolly Parton, Jerry Reed and Gary Stewart. RCA VICTOR two record set CPL2-1014.

Recorded live at the Grand Ole Oprey House, in Nashville, Tennessee, and featuring six of the top country artists in America, this album makes very pleasant listening. The cover has brief pen portraits of the featured artists, as well as giving details of how this album came to be recorded.

There are too many tracks for me to list them all, so I'll compromise, and list those that I liked most: Jolene (Dolly Parton)—That Girl Who Waits On Tables (Ronnie Milsap)—Kiss An Angel Good Mornin' (Charley Pride)—The Entertainer (Chet Atkins)—Lord, Mr. Ford (Jerry Reed).

If you're a country music fan, this album would be hard to go past. Technical quality is good; my only criticism is that I didn't like the endless breaks for commercials, which may be necessary for a TV show, but have no place in a record. (D.W.E.)

★ ★ ★

SUPERCHARGED MOOG. Paddy Kingsland. Studio 2 stereo TWOX 1024.

I had expected some fairly explosive sounds when an Irishman drove a synthesizer but maybe Paddy Kingsland does not hail from Belfast! Let's not get bogged down about it though. (Sorry 'bout that.) A fair assessment would have to rate it as just a routine performance that is easy enough on the ear. Okay as an accompaniment to driving or housework. Quality is a pass.

Twelve tracks are featured: Money, Money – Cecilia – Gollum – Autumn Dream – The Wombling Song – Wobulator Rock – Killing Me Softly With His Song – Top Of The World – Fillet Of Soul – Splashdown. (L.D.S.)

. . . and vintage trains!

THE LAST RUN . . .? Stereo, Locofonic LRS-003. (From Locofonic Recording Service, P.O. Box 124, Northbridge 2063. $6.50 incl. p&p.)

The question marked which forms part of the title seems to suggest that the makers of the record don't quite accept the edict of the NSW Commissioner of Railways that no further journeys will be permitted by steam locos on mainline tracks. On a disused loopline, maybe, but that's all!

The whole of side 1, recorded from a window immediately behind the loco, is devoted to a Sydney-Newcastle run behind a 60 class Garratt. And just as you might settle down to read the paper on a real journey, you can occupy your time reading the columns of fine print on the double fold jacket as the Garratt copes with gradients, wet rails and tunnels.

Side 2 is a series of track-side episodes as the recordist captures the sounds of a journey over the Blue mountains and return of a train drawn by no less than three historic locos: the old faithful 32 class, its souped-up successor the 35, and the pride of the NSW express passenger service, the high pressure 38.

Its a generous and well recorded album, a fitting farewell to steam in NSW and yet, as I listened to—and read about—the struggles of the locos against slippery gradients and heavy loads, the inevitability of their displacement became ever so obvious. This from one who used to watch engines like others watch racehorses!

But let's not spoil the mood. This is a fine recording of a past era, well documented and well presented; convincing on loudspeakers but even more so on stereo headphones. (W.N.W.)

ORGANS: pipe & electronic

A WEDDING ALBUM. Peter Bebington (Organ). The Choir of St Mary's Cathedral, Johannesburg with Nigel Whitman (Organ). His Masters Voice Stereo SOELP 10215.

When you think of it, a wedding album is a very good idea. Some brides must lack inspiration because they certainly walk down the aisle to some peculiar tunes. I have even heard of one benighted bride accompanied by "What Kind Of Fool Am I?" Inapt, I would say.

Another likely reason for the album's existence is to provide happily married couples with a souvenir of their wedding day. The tunes featured run the gamut of those conventionally played at weddings and are rendered in very professional manner by the choir and organists.

Record quality is generally good although there was some edginess on several of the choral tracks. Surface noise was negligible.

Track titles are: Trumpet Voluntary – The Lord's My Shepherd – Toccata From "Fifth Symphony" – Psalm 128 – Jesu, Joy of Man's Desiring – Blessed Are The Pure In Heart – O Perfect Love – Wedding March From "A Midsummer Night's Dream" – Brother James' Air – Trumpet Tune & Air – O Father All Creating – Bridal Chorus From "Lohengrin" – Love Divine, All Loves Excelling. (L.D.S.)

★ ★ ★

HORACE FINCH playing the organ of the Empress Ballroom, Blackpool. Mono BBC Records REC-129M (from Phonogram).

From being a church organist at the age of 9, and pianist for the Blackpool Ballroom orchestra at 20, Horace Finch became solo organist for the Ballroom, shortly after, at the age of 27. His career lasted until 1962, when his left hand was damaged in an accident. The respective sides of this record contain programs, broadcast in the BBC Light service during 1958 and 1959.

According to the jacket notes, Horace Finch used full registration and the crescendo pedal sparingly, preferring lighter registrations, and improvisation aided by the second touch facility giving him, in effect, an extra set of fingers!

Side 1 opens with "With A Little Bit Of Luck", "I'll Walk Beside You" and "Firefly", followed by a bracket entitled "Dancing Through The Years". Another feature number "The Whistling Sergeant" leads into the final bracket "Yesterday's Tunes". On side 2 are two feature solos "Under The Double Eagle" and "Windmill", and two brackets "Memories Of Jolson" and "Tunes Of The 50's".

Although mono recordings more than 15 years old, the quality is quite okay. Even so, it will be of interest primarily to collectors of popular organ music, and those keen to study the style of yet another famous British organist. (W.N.W.)

★ ★ ★

REAL THEATRE ORGAN SOUND! Dwight Beacham Plays the Allen Computer Theatre Organ. Stereo (no brand), AOC-423-1.

With their reputation well established for "church" style voicing, the Allen Organ Company has planned their new "Music Scene" model to cater more deliberately for those requiring "theatre' sound; this is the instrument featured here.

Dwight Beacham, a youthful organist unknown to me up to now, is a very capable artist but the fact that he is so young makes it difficult for him to recapture the atmosphere of the theatre as we "oldies" knew it.

An important point is that the recording was made in an environment with very little reverberation. While this has also worked against "theatre" atmosphere, it does give a good idea as to how this type of organ would sound in a typical lounge room. The theatre voicing is particularly good in the tibia and reed sections.

The items played–about twelve in all: I Get A Kick Out Of

You—Let A Smile Be Your Umbrella—The Entertainer—You And The Night And The Music—Deep In A Dream—I'm Gonna "Keep On Singin"—I Love To Hear You Singing—Garden In The Rain—Sunday—Liberty Bell March—Speak Low—Carissima.

My review copy came from Allen Organs (Aust). Copies at $4.00 each (or $5.00 posted) are available from the above company at either of the two addresses: 32 Woodhouse Rd, Doncaster East, Vic 3109); or 39 Roland Avenue, Wahroonga NSW 2076. (I.L.P.)

A TOUCH OF COUNTRY. John Cootes. Festival stereo L 35507.

John Cootes certainly has many strings to his bow and he is not a bad singer either! In fact, he has a good reputation as a club artist, his voice being somewhere between tenor and baritone. He does not overdo the country bit on this album so the title is quite appropriate.

Recording quality is passable but the local Festival studio can easily do better. Surface noise on my sample was negligible.

Tracks featured are: Too Many Times – Kiss An Angel Good Morning – If You Leave Me Tonight I Will Cry – Why Me – Reuben James – It's Worth Believing – Don't Fight The Feelings Of Love – If I Needed You – Easy Lovin' – Cotton Jenny – The Taker – Help Me Make It Through The Night (L.D.S.)

12 GOLDEN HITS OF FREDDY GARDNER. Played by Trevor Furner. RCA Victor stereo SP-157.

Mention the name Freddy Gardner to any fan of the solo saxophone and you will have named the legendary genius of all saxophonists. In the 25 years since his death I suspect that his reputation has grown quite a deal. And I don't mean this unkindly. If Freddy Gardner was alive today he would undoubtedly be amongst the best but the music he played 25 years ago sounds a little tired today.

I should point out that Trevor Furner is a very fine exponent of the saxophone and does justice all the tunes. Musical arrangements are in strict tempo and as such it is a good album for ballroom dancing or just quiet relaxation. None of the tracks could be said to "pick you up and set you on your ear", as some of today's saxophonists are apt to do.

So before you rush to buy this album with its famous name, have a listen to some of the tracks. Recording quality is good and surface noise is negligible.

The twelve "golden hits" are: Stardust – Roses Of Picardy – The Japanese Sandman – Because – Ah! Sweet Mystery Of Life – Valse Vanite – Smoke Gets In Your Eyes – Sleepy Lagoon – Moonlight And Roses – These Foolish Things – Diane – I'm In The Mood For Love (L.D.S.)

★ ★ ★

THE WOODS SO WILD. Julian Bream, Lutenist. RCA Red Seal stereo LSC-3331.

Let not the title of this album mislead yee, for the melodies contained therein are most civilised and lyrical. "The Woods So Wild" was in fact a tune popular in Renaissance times and was even sung by Henry VII. Perhaps this album could have been called "Music from the Renaissance" for it all originates from about this time.

So if you have a yen for this music to soothe and console then here is the ideal prescription. The playing of Julian Bream is superb and the recording quality excellent. Put this one down as one to buy.

Apart from the title tune, the tracks are as follows: Fantasia I – Packington's Pound – Fantasia II – Walsingham – Fantasia III – The Fairy Round – Heigh Ho Holiday – Fantasia IV (La Compagna) – Go From My Window – Greensleeves – Fantasia V – Bonnie Sweet Robin – Fantasia VI – Heart's Ease – Fantasia VII and Fantasia VIII – Loth To Depart. (L.D.S.)

★ ★ ★

BARRY CROCKER Sings The Hits. With the Tony Hatch Orchestra. Stereo, Astor ALPS-1042.

In contrast to the "Show" evergreens which have won him so much favour, Barry Crocker, in this budget-priced album, concentrates on more recent and less well known "Hits". There are fourteen of them, altogether, in a generous program: The Most Beautiful Girl – A Special Place In Heaven – Back Home Again – Room Full Of Roses – Annie's Song – Blue On Blue – Sunshine On My Shoulders – You Make Me Feel Brand New – The Way We Were – Like Sister And Brother – I Honestly Love You – You're My World – Seasons In The Sun – Give My Love To Your Folks.

In his stage songs, Barry Crocker projects a big voice against a big orchestral backdrop. The mood here is quieter, more intimate, with backing to suit but it's all very easy on the ear, cleanly recorded and excellent value for the money if the songs take your fancy. (W.N.W.)

★ ★ ★

BANG BANG RHYTHM. Sandy Nelson. United Artists L35491. Festival Release.

The tracks on this album have all been chosen especially for dancing. In each one, Sandy drums up quite a foot-tapping rhythm, so that even older folks should be able to "swing their hips" a little.

The ten featured tracks are: Never Can Say Goodbye – Rock Your Baby/Rock The Boat – Blue Eyed Soul – Get Dancin' – Bang Bang Rhythm Part 1 – I've Got The Music In Me – You And Me – Doctor's Orders – In A Gadda-Da-Vida –Bang Bang Rhythm Part 2.

As you can see from the titles, the record is aimed at the discothequer, and features a wide selection of Seventies style music. It would be very suitable for use at a party, or similar gathering. The record quality is excellent. (D.W.E.)

Books & Literature

College text

ELECTRONIC CIRCUITS AND SYSTEMS, by Robert King. Published by Thomas Nelson & Sons Ltd, London, 1975. Soft covers, 234 x 157mm, 355pp, many circuits and diagrams. Price in UK £4.95.

A modern introduction to the principal devices used in electronic circuits, their properties and behaviour. It is written for the university undergraduate, both in electronics and electrical engineering and in other engineering courses which need a basic grasp of electronics. The author is a Senior Lecturer at Imperial College, London.

In keeping with its modern slant, the book concentrates on solid state devices, and gives but a passing mention to thermionic valves. In sequence it deals with diodes, FETs, bipolars, thyristors and ICs, developing basic circuit models from physical descriptions. The models are then used in analysis of small and large signal behaviour of functional circuits and systems.

The emphasis throughout is on understanding the principles of operation, not simply network analysis for its own sake. The text appears to be written in very clear and concise language, and is well served by a large number of clear diagrams. Each chapter concludes with a list of references and a set of tutorial questions, to which answers are given at the end of the book.

In short, a very impressive college-level introduction to electronics, and one which should find itself very soon on the recommended text lists.

The review copy came direct from the publisher, who gave no indication about local price or availability. (J.R.)

Dictionary—at last!

CHAMBERS DICTIONARY OF SCIENCE AND TECHNOLOGY, Volumes 1 and 2. Published by W. & R. Chambers Ltd, Edinburgh, 1975. Soft covers, 130 x 196mm, 1296pp total, some diagrams. Recommended price $4.95 each volume.

Although technical dictionaries are extremely useful books, they have never been very thick on the ground. And in recent years they have tended to be conspicuously absent, presumably because the ever-accelerating expansion of technology has made their compilation ever more daunting than before.

This being the case it is a pleasure to see this new work by W. & R. Chambers, first published last year in hard cover form and now published as a two-volume paperback. The editors are T. C. Collocott, MA, and A. B. Dobson, BSc, and I think they are to be heartily commended on their efforts. It must have been a herculean task, to say the least.

Of course I am simply stating the obvious to suggest that this work deserves a place on the reference shelf of everyone even remotely interested in science and technology. It would deserve this in any case, if for no other reason that it is what it is, and has been published as recently as it has. But as it happens, the book gives every evidence of being well planned and executed, and therefore even more valuable than otherwise.

Of course, it is always possible for someone familiar with a certain field to find omissions and minor errors. I was mildly surprised to find no entries for magnetic bubbles or bucket-brigade devices, but these perhaps came into wide use after the book was prepared. It was more disappointing to note the omission of many common acronyms like ASCII, MOS, LSI, ERP and PCM—although the full equivalents of some of these were given.

Still, no one is entitled to expect perfection, particularly in a work of this size selling for only $10! Frankly, I think it is a very commendable effort indeed, and excellent value for money.

Incidentally the first volume includes a list of subjects and abbreviations, a list of other abbreviations, and a table of SI conversion factors. The second volume has a reproduction of the periodic table of the elements, together with a data table of the elements.

The review copy came from the local representatives for Chambers, Thomas C. Lothian, who advise that copies should be available from all major bookstores. (J.R.)

Digital systems

ANALYSIS & DESIGN OF DIGITAL SYSTEMS, by Vasil Uzunoglu. Published by Gordon and Breach Science Publishers Ltd, London, 1975. Hard covers, 160 x 236mm, 506pp, many diagrams. Price in UK £16.70.

A book designed for the fairly advanced design engineer, the research scien-

tist and the graduate student. It aims at bridging the gap between theory and the final design of modern digital systems, in particular those concerned with control and communications.

The design approaches taken are fully analytical, and make use of modern functional components such as ICs, MOS switches and multiplexers, etc.

The material covered is well shown by the chapter headings: 1—Introduction to Pulse Code Modulation; 2—Multiplexers; 3—Sample and Hold Circuits; 4—Analog to Digital and Synchro to Digital Converters; 5—Shift Registers and Generation of Codes; 6—Matched Filters, Equalisers and Digital Filters; 7—Some Useful Modulation and Detection Techniques; 8—Phase-Lock Loops and Synchronisers. The book ends with three data and reference appendices.

Broadly speaking the book seems to represent an attempt by the author to pass on to others the wealth of knowledge and practical design experience he has been able to acquire over many years of high-level research and development. From a necessarily brief and ignorant examination, I believe he has achieved this aim very well.

In short, a book which should be of interest and great value to anyone working in digital R & D.

The review copy came direct from the publisher in London, who gave no details regarding local price and availability. (J.R.)

Letters to the editor

The Novice Licence fiasco

The Editorial Viewpoint in your October issue surely will have shocked a great number of your readers and certainly a large majority of members of the WIA.

Are we to understand that your Editor's "inclination to suspect" derogatory things of the WIA, for which he has no proof, is prompted by a personal grudge?

In the next paragraph, by innuendo, he suggests that unlicensed Pirates should continue their illegal activities rather than take the simple Novice exam.

From his privileged position your Editor has done great damage not only to the WIA but to your highly respected publication. It would seem that some comment from your Editor-in-Chief is the least your readers and the Postmaster-General could expect.

Rob. Wilson, VK5WA
Nth Adelaide, SA.

EDITOR-IN-CHIEF'S COMMENT: The whole question of the Novice Licence seems to have become emotionally charged. Rather than try to condemn or uphold Jim Rowe on this basis, it would be far more meaningful to seek an honest answer to a question of fact: Did the PMG Department impose the 2-year limit on the Novice Licence entirely on its own initiative, or was it prompted to do so by a group from within the WIA? On your second point, it is not the policy of E.A. to encourage "pirate" operation. Jim Rowe was simply expressing the opinion that an emasculated Novice Licence will not provide any strong incentive to "go legit". With this I agree. Anti-novice forces, in winning a skirmish, may well be setting themselves up to lose the war against pirates. (W.N.W.)

And with the facts:

I draw your attention to the press release by the Postmaster-General, Senator R. Bishop, which was reported in "A.P.O. NEWS" and which gave official approval to the introduction of Novice Licensing. In this release there was no mention whatever of any proposed "two years' tenure" and, one may assume, interested readers would have proceeded with their inquiries and applications unaware that this requirement would be imposed at a later date. I point out that verbal inquiries to the Radio Branch Office in North Sydney indicated that no limitation of tenure had been circulated within the Radio Branch at that time.

Somewhat later there became available Form RB-125A which was sent to persons inquiring about Novice Licensing. In that form there is no mention of a "two years' tenure". However, I have a photostat copy of a letter from the Controller, Radio Branch, Mr. H. Young (Ref. 320/5/51), dated 26 March, 1973, apparently sent to the Federal WIA in reply to representations made by the Federal Institute administration suggesting a "four-layer" Amateur Licensing structure and other points related to the Novice proposals. I note that this letter contains the following: "It is agreed that Novice licences will be issued on a two year tenure only . . ."

I point out that the WIA Novice Investigation Committee, of which I was Chairman and which completed a tremendous amount of work and research, recommended that NO LIMIT of tenure should be applied to Novice operators. This was the consensus of opinion among a large number of WIA members as obtained by letters, telephone calls and personal questioning. However, in its wisdom, the Federal Convention decided that a "two year tenure" should be requested and the Radio Branch complied.

It is noted that the Committee's recommendation for a five years' trial period was accepted, but it is felt that there is still room to offer suggestions before the Novice project commences rather than to have disadvantageous elements introduced now and then to find that "long custom" during the five years of trial makes the elimination of such elements an administrative problem.

Since the two years' tenure has become known by would-be-Novices unaware of the previous negotiations, considerable dissatisfaction has been expressed. I know of 27MHz unlicensed operators who have abandoned the notion of gaining Novice licences on the basis of the two years' tenure and the long delay in holding Novice examinations. I point out, also, that one of the valuable sources of Novice Licensees would be Science teachers conducting School Radio Clubs and/or Electronics COURSES in High Schools—State and private. What possible incentive would these people have to strive for such a transient qualification? The aim should be to attract as many as possible of such qualified persons into Amateur Radio—NOT to inhibit them.

Senator Bishop's Press Release stated that Novice Licences will be available to persons "regardless of age". It is, therefore, possible to envisage boys of Primary and lower Secondary School ages gaining Novice Licences, but surely even the most obtuse Institute administrators will be able to see that a two years' limitation would make it impossible for such licensees to reach the dizzy heights of AOCP status. After all, Australian AOCP standards with the 70 per cent pass mark are among the highest in the world. At the other end of the scale, consider elderly and retired persons who undertake Novice operating as a pleasurable activity in their later years. Are these to be given only a limited period to enjoy the available years and to make a contribution to Amateur Radio in the Novice area? What about the many lads of middle and upper High School grades whose extent of Novice operating will be limited by school studies and public examination requirements? Why should these young people be pressured into AOCP studies because of the short-sighted policies instigated by the people responsible for "pushing" the "limited tenure" conditions?

The time to "squash" this new element is NOW—before the Novice system actually commences.

R. C. Black, YK2YA
Chairman, WIA Novice
Investigation Committee
Founder, Youth Radio Scheme

COMMENT: Many thanks for your letter, Mr Black. It certainly sets the record straight, and confirms the suspicions I expressed in the October editorial. It is reassuring that you and your committee apparently shared, and still share, our misgivings about the 2-year tenure limit.

But when is the exam?

I read with interest your editorial in the October issue of EA re the Novice Licence. This controversy is of particular interest to me, as I have for many years been interested and active in amateur radio.

Being an ex PMG telegraphist, my interest has always been in CW, and with the announcement of the exam for the Novice I decided that at long last I could see myself on the air pursuing my hobby.

I enclose a copy of a letter received from Senator Bishop in answer to a few queries. You may find it interesting, particularly paragraphs 2 and 5.

K. J. Callahan
Elsternwick, Victoria.

Senator Bishop's letter to Mr Callahan reads:

Dear Mr. Callahan,

I have received your letter of 5.9.1975 concerning the examination for the Novice Radio Operator's Certificate of Proficiency.

The industrial dispute which has so far prevented this examination from being held, concerns staff classifications. The parties involved in the dispute are the Australian Public Service Board, the Staff Association representing the officers of my Department who conduct examinations and, to a lesser extent, my Department.

Attempts to reach a solution to the dispute are being pursued as expeditiously as possible. Noting, however, that certain instructions have been given to staff by their Association, it would be pointless to attempt to re-schedule the examination until the difficulty is resolved.

The dispute has already been widened to include other examinations conducted by my officers and I am loath to initiate any action which could precipitate further disruption of my Department's activities.

I regret that some inconvenience was caused to candidates but I am sure you will appreciate that the postponement is outside the control of my Department.

You may be assured that following settlement of the dispute, the earliest practicable date will be selected for the examination and all candidates advised accordingly.

R. Bishop
Postmaster-General
Adelaide, SA.

Changing the subject:

In regard to your articles on the Citizens Band, I think the reason for the lack of response on this matter is due to the pirates on this band. Their inconsiderate actions, as illustrated in your article, has scared off most of the legal users of both the 27MHz amateur band and the general purpose frequency 27.240MHz. Leaving only themselves who are too ignorant, and busy pirating, to worry about it. Thus no reaction.

The 11m (27MHz) amateur band is probably the best amateur band there is. Besides the cheap equipment, this band offers excellent ground propagation and excellent DX in the summer time. But the pirates have made life hell for the legal users of the band by constantly jamming amateurs and generally being a nuisance.

Currently there are not more than a dozen amateurs using the band in Sydney yet the number of pirates is easily double that amount.

I think most of the points brought up in your articles are agreed with by most amateurs I have spoken to, although a legal CB would probably encourage pirating on the amateur bands. Pirating on the amateur bands is nothing new, it wasn't that long ago there were pirates on 40m and the novice licence may introduce this again.

Finally it should be made clear that from 26.96MHz to 27.23MHz is an amateur band reserved for those with either a AOCP or ANOCP. The 23 channel rigs on the market include most of this band and therefore the only people who are legally allowed to have one are amateurs. Others found with them in their possession are liable to have the equipment confiscated and are liable for a fine and/or imprisonment.

Amateurs are in theory a secondary service on the 11m band, secondary to hospitals, etc. But in my opinion it is really a pirate band with amateurs as a secondary service.

Peter Vernon, VK2PV.
Rose Bay, NSW.

On the other hand. . .

A lot has been said in your magazine on the subject of Citizens Band and pirate operators. It has nearly always been from the opposite point of view, that is anti-CB and anti-pirate. I would like to tell what my views are, and the views of many others throughout Australia.

For a start, many of us are not capable of passing an Amateur examination because we do not know enough electronics to get through. We do know enough to get our selves on the air. Now, this leaves you several arguments and I will attempt to deal with these arguments and show you our point of view for once.

I said that many of us don't know enough electronics to get through an Amateur examination. You might say "why don't you study then?" The answer is simple. Not all people have got the time to study. This could be due to shift working, having to work in with the rest of the family, or any number of things. You must also remember that not every one can take in a particular subject, and electronics is no exception to the rule. Just because a person is interested in radio it doesn't mean that they can study it and make sense of it.

One of the big arguments against CB is that it causes interference to other legal operators. 27.24MHz is the frequency used by building workers, life savers, bush walkers, etc. Many of the 250,000 serious operators in Australia do not operate on this frequency. True, there is interference caused by shock wave, but what difference is there between a licence free Citizens Band operator and a Novice? Both are going to cause interference.

This brings us to another point: why don't we get a Novice licence? Most people could find time to study for something as easy as that. True, but what point is there in going legal for two years only? A small number of Novices will be able to pass an Amateur exam, but a large majority will have to either go off the air, or go illegal. I feel sure that if the Novice licence was a permanent licence, then you would see a big drop in the number of illegal operators on the air.

The majority of CB-ers are good guys. We are only too willing to help. This has been displayed many times. Remember Darwin? It was a CB-er who got the first message out of Darwin. We don't like the fools who get around deliberately jamming legitimate transmissions, either. We try to get them on to the right track. Sometimes we are successful, other times, not so. But DON'T judge all pirates by one or two fools who spoil it for everybody. Most are willing to help you if you ever need it.

"Gary"
(No address given)

Electrical safety

In the May and June 1973 issues of Electronics Australia, Mr P. Emery gave two concise and informative articles dealing with some important aspects of electrical safety. In the second article, he mentioned that of the forty electrical fatalities which occurred in 1969 in NSW, over half of them were associated with flexible cords and their fittings.

Figures by the Electricity Authority of NSW revealed that in 1974, there were forty-five electrical fatalities occurred in NSW and twelve of which were resulted from unsatisfactory flexible cords. The cords were either connected incorrectly such as having the active wire connected to earth, or the earth wire became detached. These errors are particularly easy to make in home-made extension cords. In ordinary plugs and plug sockets, it is tedious if not impossible to examine the connections every time we use them. However, a very convenient way to inspect the connections is to use transparent plugs and plug sockets. With these, visual examination of the wiring is always possible without any effort.

It is recommended any project, particularly a DC power supply, which has a metal case and uses mains power should be equipped with a transparent plug so that the earthing can always be checked.

Daniel K. Wong, B.E.(Hons.)
Harris Park, NSW.

COMMENT: The idea of transparent plugs and plug sockets certainly seems a good one. Apparently these items are available, although they don't seem to be widely stocked. Perhaps your letter will help the situation by increasing the demand for them.

NEW ALL-TRANSISTOR STEREO AMPLIFIERS
ULTIMATE IN DESIGN—LONG DEPENDABILITY

Using all silicon transistors 50 WATTS—RMS

NEW C800 STEREO AMPLIFIER

SPECIFICATIONS

POWER OUTPUT:
25 watts per channel R.M.S. Total output 50 watts R.M.S. 8 Ohms.
FREQUENCY RESPONSE:
20 cycles to 40,000 ± 1dB
HUM & NOISE:
Aux. 70dB. Mag. 60dB.
INPUT SENSITIVITY:
Mag. 2mv. Aux. 250mv.
EQUALISED:
Mag. RIAA.
TONE CONTROLS:
Bass 50 c s ± 13dB. Treble 10kc s 15dB.
HARMONIC DISTORTION:
Less than 0.1 per cent.
LOUDNESS CONTROL:
50 c s 10dB.
SCRATCH FILTER:
(high filter) at 10kc s 5dB.
RUMBLE FILTER:
(low filter) at 50 c s 5dB.
PROVISION FOR TAPE RECORDER:
Record or playback with din plug connector.
SPEAKER SWITCHING:
Two sets of speakers can be connected and selected by switch on front panel; they can also be driven together
HEADPHONES:
Headphone jack is situated on front panel.
DIMENSIONS:
16½in. x 11in. deep x 5" high. Weight 16lbs.
POWER SUPPLY:
Regulated power supply with switching protection for output transistors.
SEMICONDUCTORS:
33 Silicon transistors plus 7 diodes.

- ✻Elegant and functional design
- ✻Push-button controls
- ✻Microphone input with separate control
- ✻Provision for simulated 4 channel stereo
- ✻Cabinet in teak or walnut oiled finish with matching metal trim

$169 *

✻(FREIGHT EXTRA) WITHOUT CABINET $157.00

—NEW MAGNAVOX FOUR-WAY SPEAKER-SYSTEM—

FREQUENCY RESPONSE 35Hz to 25KHz POWER HANDLING CAPACITY 30 Watts R.M.S.

DRIVE UNITS: Magnavox 8-30 high performance 8" bass unit. Magnavox 6J 6" mid range speaker. Magnavox new high fidelity dome tweeters (two supplied).

SPEAKER KIT: (less cabinet) comprises above speakers, 1mh inductance, 1 8mfd. & 1 4mfd. polyester capacitor, 1-3" & 1-6" tube, innabond, speaker silk & plans of cabinet.

Post & packing reg. post $5.50 extra.

$48.00 per kit. CABINETS AVAILABLE FOR ABOVE KITS.

SPECIALS FOR DECEMBER...

PLAYMASTER 143 AMPLIFIER

As featured in Sept. & Oct. 1974 issues of Electronics Australia.

$65.00

Complete kit of parts including all transistors for this high fidelity 25 watt amplifier, silver anodised panel with black lettering and matching silver anodised knobs & special transformer with electrostatic shield. Reg. post & packing $3.00 extra.

De luxe version of the 143 amp. with high & low filters as used in the 140 playmaster plus loudness control **$7.80 extra.**

NEW A.M. TUNER & MANTEL RADIO

Six transistor A.M. tuner with a variable output suitable for use with any amplifier or tape recorder. Inbuilt audio amplifier & speaker enable this unit to be converted to a mantel radio at a flick of a switch.
Supplied in attractive wood grain finished cabinet. 240v A.C. operation. Suitable for local stations only.

Post & packing $1.50 extra.

$15.00

GENESONICS 10 SOLID STATE PORTABLE

This sensitive & selective pocket radio using 6 transistors & 4 diodes is suitable for most local & country areas. Fitted with a 2¼" speaker and supplied in attractive & durable plastic cabinet. Earphone supplied. Operates on 2 1.5V pen cells.

$5.95 Post & Packing 90c *(All spare parts available)*

CLASSIC RADIO

245 PARRAMATTA RD, HABERFIELD 2045
PHONES 798 7145, 798 6507

Improving the Mk 2 PAL-S colour TV decoder

After doing some further work on his "Mark 2" PAL-S colour TV decoder described in the May and June issues, the author has discovered a few shortcomings. In this brief note he explains how they can be easily and cheaply overcome.

by ANDREW PIERSON

The following circuit changes to the Mark 2 PAL-S decoder have been found necessary to ensure consistent performance with all types of input signals.

APC CIRCUIT

At present, the ALT-V signal is AC coupled to the burst switch. Whilst this is generally satisfactory, the U and V components of some signals are such that considerable shifting of the base line can occur when phase errors are present. Since the effect will reduce the efficiency of the APC system, it is necessary to carry out a modification. Delete C56, R94, R95 and add the circuitry shown in Fig. 1.

This circuit clamps the ALT-V signal to a constant value during the sync (i.e. no-colour) period in each line, so that the burst switch always operates from this level, regardless of picture colour content. After installation of this modification, turn down the SATURATION (RV6), and repeat step 12 of the alignment procedure.

SYNC SEPARATOR

The dynamic range and timing accuracy of the sync circuitry can be greatly improved if the sync separator is preceded by a clamp and video clipper stage. Delete C6, C7, R13, R14, R15 and add the circuitry shown in Fig. 2.

To set up the circuit, look at the TP with a CRO, and adjust the VIDEO CLIP pot, to remove most of the video information. This leaves a roughly separated composite sync waveform, and the sync separator (Q5) now acts mainly as a squaring amplifier.

IDENT RECOVERY

Reduce the time constant of the clamp as follows:

Delete R114 and replace with a link
Change C67 to 10 nF (polyester)
Change R115 to 4.7 k ohm.

CHROMA BANDWIDTH

The reception of transmitted signals will be enhanced by increasing the value of R5, which narrows the chroma bandwidth and thus improves the signal to noise ratio. Because this is achieved by increasing the Q factor of TR1, the chroma gain is also increased. The –6 dB bandwidth should not be taken below 400kHz from its present value of 1.6 MHz, or serious degradation of the displayed colour information will occur. Reduction of the chroma bandwidth should only be carried out if the circuit is used to decode off-air signals.

It should be stressed that maximum immunity to noisy signals can not be achieved until the chroma channel is blanked off during the monitor's clamping period. This facility is included in the Mk III circuit, yet to be described.

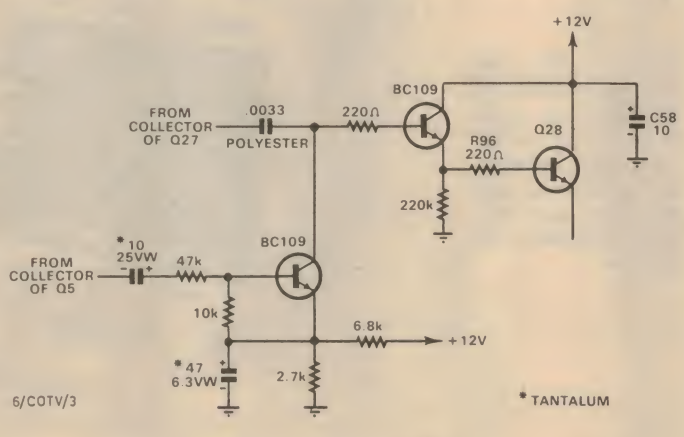


Fig. 1: The addition of an active or keyed clamp to the input of the burst switch, to improve APC operation.

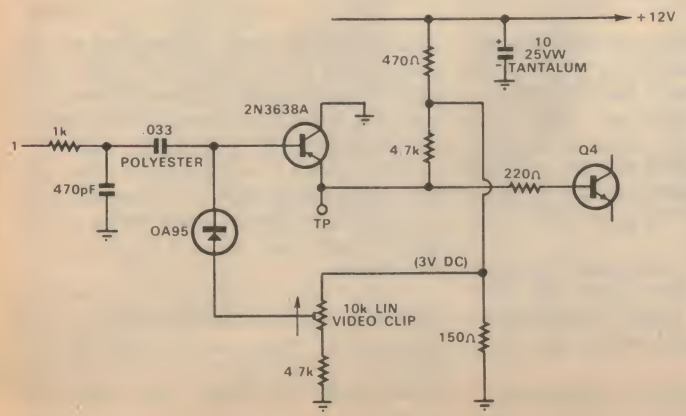


Fig. 2: The addition of a clamp and clipper to the sync separator input, to improve its dynamic range.

New Products

Trio CS-1560 15MHz Dual Trace Oscilloscope

Trio now have released a new dual trace oscilloscope with bandwidth from DC to 15MHz and maximum sensitivity of 10mV/cm. It has all solid-state circuitry, very low power consumption and a regulated power supply to make it insensitive to mains voltage fluctuations.

Designated the CS-1560, the new Trio oscilloscope supersedes the CS-1554 dual trace model we reviewed in the June 1975 issue. The new model is completely different from the old, with simplified control layout and up-to-the-minute circuitry.

Dimensions of the new model are 250 x 200 x 370mm (W x H x D) and mass is 7.1kg. A tilting bail is fitted to enable a more convenient viewing position.

Vertical deflection sensitivity is variable in eleven ranges from 10mV/cm to 20V/cm, with continuous variation on each range available from a small knob concentric with the range switch.

Nineteen ranges in a 1-2-5 sequence are provided for the timebase, with continuous adjustment again available from a small knob concentric with the range switch. In addition, the horizontal trace position control can be pulled out to provide a 5X magnification of the sweep signal.

An attractive feature of the timebase switch is that the variable knob can be rotated fully clockwise to give the X-Y operation, with the CH2 signal becoming the horizontal component. This makes Lissajous figure operation or similar comparison of two signals an easy matter. And the fact that the full gain of CH2 (10mV/cm) is available makes it even more attractive.

Two switches and a small control knob give fairly comprehensive sync and trigger selection facilities. The TV line and TV frame sync pulse triggering facility which was present on the superseded CS-1554 model is now incorporated into the timebase switch and is automatically selected depending on the timebase range. Similarly, the facility to select chopped or alternate trace operation is now incorporated into the timebase range switch.

Elimination of the above-mentioned control facilities helps to simplify the panel layout without reducing operator convenience.

Five display modes are available: CH1, CH2, CH1 and CH2 (dual), Add and Subtract. Input signals to the Vertical inputs can be AC or DC coupled or grounded. Input impedance is 1M shunted by 22pF. AC bandwidth is 2Hz to 15MHz (−3dB points).

Internal layout of the CS-1560 is clean and uncluttered with comparatively little wiring between PC boards. Three large PC boards accommodate the circuitry in three sections, Vertical Amplifiers, Timebase and Sync/TriggerCircuitry and the Deflection Amplifiers and Power Supply. All switches and controls are wired directly to the PC boards and all connections between boards are made via quickly-disconnectable plugs and connectors. All the boards can be quickly removed from the chassis as can the CRT which is taken out through the front panel.

We counted five integrated circuits. Four of these are 7400 series TTL IC's used in the timebase. There should be no problem here if replacements are ever needed.

Trio note that special attention has been paid to the blanking circuitry in this model and we are able to report that it is a great improvement over the blanking circuitry of the superseded CS-1554.

In fact we found the CS-1560 a delight to drive and use. It has the full 15MHz bandwidth available at deflections up to 6cm and maximum sensitivity of 10mV/cm. Traces are bright and sharp and waveforms with fast risetimes are easily viewed. The whole unit appears to be a well-conceived piece of equipment. We can recommend it for laboratory or hobbyist use.

Accessories supplied include the instruction manual (not available for our perusal at time of writing), a couple of pin plugs and two PC-17A probes. These probes may be switched from 10:1 attenuation to direct connection by disconnecting the tip portion of the probe and reinserting after rotating through 180 degrees. Input impedance in the attenuation mode is 10M shunted by 18pF.

Price of the CS-1560 is $399 plus sales tax where applicable. This includes the two PC-17A probes and other accessories noted above, so it is good value for money.

Further information can be obtained from the Australian distributors for Trio instruments, Parameters Pty Ltd, 68 Alexander Street, Crows Nest, NSW 2065 or from major electronic parts suppliers. (L.D.S.)

The CS-1560 does not have plug-ins but the front panel does have easily removable sections for access to the Timebase and Vertical Amplifier PC boards.

YEW 3223 taut band multimeter

This new FET multimeter from Yokogawa Electric Works (YEW), type 3223, features a taut band movement, mirrored DC / AC common scale, an input impedance of greater than 10 megohms, and a frequency range on AC measurements extending beyond 1 MHz.

The unit is housed in a shock-resistive ABS resin case, measuring 134 x 195 x 90mm, including the carrying handle. The bottom is fitted with small rubber feet, to ensure stability. The top of the unit is taken up by a large mirror-backed taut band movement.

Offset slightly to one side on the bottom half is a large range switch, having twenty-four positions. To the left of this are the ohms adjustment, the electrical zero balance adjustment, and the function switch. This has four positions, OFF, ON, −DC and B.

The first two positions are self explanatory. The −DC position reverses the probe connections, so that DC currents and voltages of reverse polarity can be measured without changing over the probes. The B position checks the battery voltage.

The eight DC voltage ranges are 0-300mV, 0-1.2V, 0-3V, 0-12V, 0-30V, 0-120V, 0-300V and 0-1200V. Two matched FET's are employed in a differential arrangement, to give an input impedance on all these ranges of greater than 11 megohms. The accuracy quoted is plus or minus 3 per cent of full scale. Using a digital voltmeter with an accuracy in the order of 0.1 per cent, we checked the accuracy, and found it to be at least one order of magnitude better than specified over most of the ranges. The movement also showed excellent linearity.

The five DC current ranges are 0-120uA, 0-1.2mA, 0-12mA, 0-120mA and 0-1.2A. The voltage drop across the meter for all these ranges is specified as approximately 280mV, and the accuracy as plus or minus 3 per cent of full scale.

The ohms scale has a two decade useful range, from 1 to 100, with more crowded sections at either end. This means that with the six ohms ranges, x1, x10, x100, x1k, x10k and x100k, it is possible to measure resistor values from less than 1 ohm to greater than ten megohms. The accuracy quoted is again plus or minus 3 per cent of full scale reading.

The five AC voltage ranges are 0-3V, 0-12V, 0-30V, 0-120V and 0-300V. A peak value rectification circuit is used, so that the meter responds to the negative peak value, but the scale has been graduated in RMS values for an undistorted sine wave. The AC scale is the same as used for DC measurements, so there should be no chance of an incorrect reading due to use of the wrong scale.

The lowest frequency which can be measured without appreciable jitter is 40Hz, while the upper frequency limit is 25kHz for the 300V range, 75kHz for the 120V range, 200kHz for the 30V range,

1MHz for the 12V range, and 5MHz for the 3V range. The accuracy at 1kHz for all ranges is specified as plus or minus 4 per cent of full scale, and the error at other frequencies as plus or minus 4 per cent of the 1kHz reading.

The AC ranges can also be used to measure levels in dB. The dB scale is calibrated to be 0dB for 0.775mV, corresponding to 1mW into a 600 ohm load. This scale is intended for use with the 3VAC range only. A small table in the lower right hand corner of the scale gives conversion factors for the other ranges.

All the circuitry for the meter is accommodated on three printed circuit boards, mounted in a stack on the rear of the range switch. In fact, these boards comprise the wafers of the switch, eliminating much point to point wiring.

Accessories supplied with the unit at no extra cost are a complete set of batteries, a pair of 1m long red and black measuring probes, and an alligator clip, which can be attached to either probe, as required. Also supplied is the comprehensive instruction manual.

An optional accessory is the type 3224 leatherette carrying case. This has a handle which can be used as a tilt stand, as well as a pouch in the lid for storage of the probes and other accessories.

In use, we found the unit to be a well-designed, rugged instrument. Although it lacks an AC current range, the high input impedance on DC ranges, and the extremely good ohms facilities should make the unit quite versatile.

The YEW type 3223 FET multitester is priced at $110 (plus tax if applicable), and the optional carrying case at $13 (plus tax). Further details may be obtained from the Australian agents, Parameters Pty Ltd, 68 Alexander Street, Crows Nest, NSW. 2065. (D.W.E.)

Remote pan/tilt head, CCU for CCTV

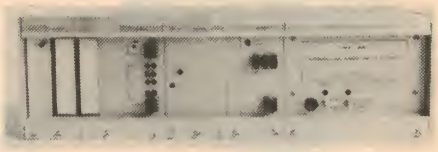
The Vicon Model V355APTV features variable speed tracking with the addition of auto-scan. With a camera mounted on this unit an area may be scanned automatically until a moving object of interest is observed, then the auto-scan disengaged and a joystick used to track the object.

The V355APTV is a rugged outdoor unit employing electronically controlled variable speed with velocity feedback to ensure a wide range of pan and tilt speeds with uniform torque. When employed with the Vicon V125APTV Vector Solving Joystick Control or the V116APTV and V117APTV knob controls, the unit provides smooth, jerk-free camera movement.

Other features include cast and plate aluminium construction, counterbalanced tilt platform with torque neutralising springs, and heavy duty gears and bearings. Limit stops are external and readily adjustable.

Enquiries to Dynetics Pty Ltd, 425E Pennant Hills Rd, Pennant Hills, NSW 2120.

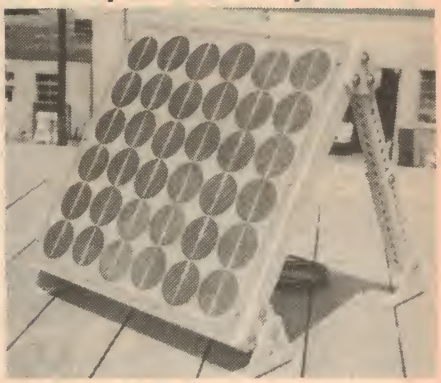
New telesignalling system



The SRC-1 Supervisory and Remote Control System uses digital techniques to convey supervisory and control information over voice frequency channels, either by radio, microwave or carrier systems. Up to 25 audio frequencies, each with a capacity of 128 on/off indications, are available for simultaneous transmission over a single voice channel in the range 300-3400Hz.

A wide variety of configurations and options are available. Details from GEC Telecommunications, 9 Bibby St, Chiswick, NSW 2046.

Solar power array



Joseph Lucas (Australia) Pty Ltd are now marketing a new solar power array.

Known as the Model E12-369-1.6, the new unit consists of 36 75mm dia. silicon solar cell wafers wired in series on a reinforced fibreglass base.

Output current is quoted as 1.6A minimum at the rated output voltage of 14.9VDC, and at 100mW/cm² solar insolation and 28°C cell temperature. These figures are for typical peak solar illumination, and give a minimum peak power output of 25W.

A Schottky barrier blocking diode is incorporated to prevent the battery from discharging through the solar cells during darkness.

Enquiries to Joseph Lucas (Australia) Pty Ltd, 1156 Nepean Hwy, Cheltenham, Vic 3192.

Power switches

A new range of high-current toggle and push-button switches for appliance and industrial use has been announced by McMurdo Components. Series 42 push-button switches are rated at 15A for both 250V AC and 12V DC, and are available in SPST, SPDT, DPST nd DPDT configurations, with either push/push or momentary action. They are SAA approved and can be provided with a variety of button styles and mounting arrangements. The type 875 toggle switch is a DPDT type rated at 16A/250V, and has been approved by the Victorian Chief Electricity Inspector as meeting AS C133 (1968). It is available illuminated if required. Both the push-button and toggle switches are fully moulded, and competitively priced.

Enquiries to McMurdo Australia Pty Ltd, 17 Carinish Rd, Clayton, Victoria.

Temperature indicators

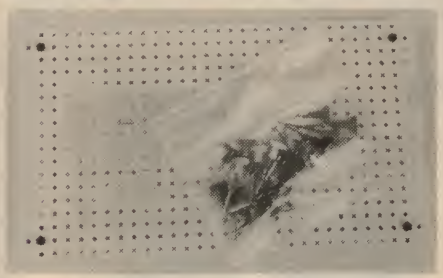
Celsipoint temperature indicators are small adhesive dots, available either singly or in order on strips, which are designed to change their colour to black at a precisely defined temperature. They are available for temperatures within the range 37.8 to 260°C. Strips with 8 or 9 dots are available in five different series to cover this range, while single dots are available for 41 different temperatures. Accuracy is ±1% of indicated temperature, and the colour change is permanent.

The dots are sealed against water, oil and other solvents, and are useful in many applications where normal instrumentation is not suitable or justified.

Available from Measuring and Control Equipment Co Pty Ltd, 9 Mobbs Lane, Carlingford, NSW 2118.

Breadboarding clips, kit

The E-Z Breadboarding kit No. 8124 is designed to allow rapid breadboarding of circuits using discrete components. Based on the E-Z Nailclip, the kit provides 24 clips together with a 122 x 22mm piece of heavy perf board (provided with rubber feet), and instructions. Very suitable for schools and colleges, as well as for hobbyists, the kit sells for $15.50.

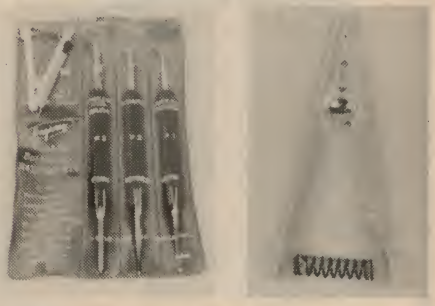


Also available in the E-Z range are Nailclip cable clamps, type 86-4, designed for either permanent harness clamping or for temporary clamping while a harness is assembled and tied.

The clips can be directly driven into wooden battens or boards, using a hammer.

Enquiries to General Electronic Services Pty Ltd, 99 Alexander St, Crows Nest 2065.

Soldering aids



Pictured above are samples from the wide range of soldering aids offered by Dick Smith Electronics. The SA-50 kit includes three double-ended tools, a heatsink clamp, and a bristle brush, for $3.50. The SA-7 heatsink clamp is also sold in pairs for $1.20.

KITSETS

STEINTRON AGAIN!

Our direct import—back again at last. Beautiful timber cabinets with louvred fronts. Absolutely superb performance.

V120:12" woofer; 6½" middie; 1½ dome tweeter; 2" super tweeter. Crossover rolloff 12dB per octave; handles 45W RMS; 20-22000Hz. Has tone control. 25½" x 15" x 11½". P&P each $5. Price each **$129**

V100: 10" woofer; 5" middie; 1½" dome tweeter. Handles 35W RMS, 20-20,000Hz. 22½" x 13" x 11½". P&P each $5. Price each **$99**

DUE TO THE POPULARITY OF THESE FINE QUALITY, HIGH PERFORMANCE SPEAKERS, WE HAVE EXPANDED THE RANGE.

V150 15" woofer, 2 x 5" midrange, 2 x 1½" dome tweeter and 2 x 2" super tweeter. Handles 55 Watt, range from 20-22,000 Hz. Price each **$199**, P&P $6 each.

V80 8" woofer, 1½" tweeter and 2" super tweeter. Handles 25 Watt 30 to 22,000 Hz. Price each **$69**, P&P $5.

SEE WHAT COLOUR YOUR MUSIC IS

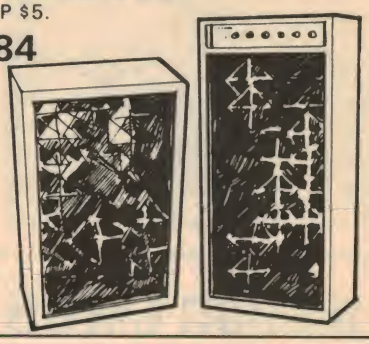
NOT a kit. These are the spectacular SECO colour organs. Connect to any speaker and the colour lamps flicker and glow with varying brightness in relation to volume, pitch and rhythm. Why put up with colour TV? Works even with small transistor radios. Leaves fibre-optic lamps for dead.

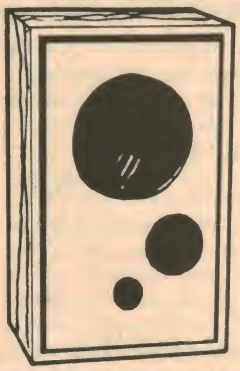
V3050: Domestic unit. 30 lamps, 3 channels, 5 colours. Diamond pattern. 18½" x 11½" x 7⅜". 3.5kg. P&P $5.

$49.50

4050X: Professional monster. 32 lamps, 4 channels, 4 colours, individual colour mixing controls and a host of other features. Ideal groups. About 30½" x 15½" x 9 ⅛". P&P $5.

$84





TOP QUALITY SPEAKER KITS

Pre-assembled & prevented speaker boxes—

ET1400	$22.50 per kit	$3 P&P
1.6 c.f.	$22.50 per kit	$3 P&P
2.5 c.f.	$26.50 per kit	$3 P&P
2.7 c.f.	$32.00 per kit	$4 P&P

Speakers available for all these kits.

NEW ETI 440 KIT

ET1440. Simple 25 Watt amplifier kit as featured in Electronics Today, July 1975.

25 Watt R.M.S. per channel, distortion round 0.1%. 6 Hz to 80 kHz., at —3 dB. A full list of specifications and building instructions are in the July issue of Electronics Today. This is a magnificent amplifier which is not hard to assemble. It will suit those people who want a good amplifier at an economical price.

$95 per kit of parts **$5 P&P**

ETI 422 50 WATT PER CHANNEL AMP KIT—SPECIAL KIT OF THE MONTH

Electronics Today ETI 422 50 Watt stereo amplifier. This high power, high quality, economical kit gives a genuine 50 Watt per channel into 8 ohms at typically less than 0.2% distortion.

Complete with teak cabinet.

$115

P&P $5.00.

KIT SPECIALS

	Price	P&P
PM 143 15 W per ch. amp.	$75.00	$5.00
PM 144 cassette deck	$99.00	$5.00
ETI 422 50 W per ch. amp.	$115.00	$5.00
ETI 440 25 W per ch. amp.	$95.00	$5.00
ET Spring Reverb Unit	$59.00	$5.00
Musicolour II 3 Ch. light and colour unit	$59.00	$4.00
Mood Colour IV 4 Ch. light and colour unit	$85.00	$4.00
Drill Speed Control E/A	$17.50	$2.00
Transistor Tester E/A	$19.50	$2.00
Glide tone Generator	$9.75	$1.00
5 State Logic Probe	$15.00	$1.00
Warble Dauble	$25.00	$1.50
E/A C.D.I.	$25.00	$2.00

PLESSEY LOUDSPEAKERS

Improve your existing loudspeakers by replacing them with these high-performance, quality units from Plessey:

	Price	P&P
x 30 1" Dome Tweeter	$9.65	$0.75
C6MR 6" sealed back mid-range	$8.50	$1.20
C100X 10" wide range twin cone	$16.25	$1.50
C12PX 12" wide range twin cone	$25.00	$2.00

PARTS SPECIAL

Stock up now on these common types at our special low prices:

	Price	P&P
¼ W. Resistor packs, mixed value, approx 200 per pack	$3.50	.50c
½W. Resistor packs, mixed value, approx 200 per pack	$3.50	.50c
Mixed value & voltage electro packs, 24 per pack	$5.50	.50c
Ceramic Cap. packs, mixed value & voltage, 40 per pack	$8.00	.50c
Semiconductor packs containing 20 trans, 10 diodes 5 I.C's	$13.00	.50c
Poly packs, 40 per pack	$7.00	.50c
Audio leads, Assortment	$3.95	.75c
Goldring cartridges, ES70E ($21.50). ES70S ($11.50)		.75c
Crystal ear pieces	$0.65	.50c
Magnetic ear pieces	$0.65	.50c
Valves 6CM5 ($1.50) 1S2A, 12AU7, 6BL8, 6AL3, ($1.00)		.50c

SPECIAL NOTICE TO CUSTOMERS: Due to economics we have consolidated both our Melbourne stores in our **BOX HILL** location and are no longer trading in **ADELAIDE**. Adelaide customers are invited to use our mail-order service.

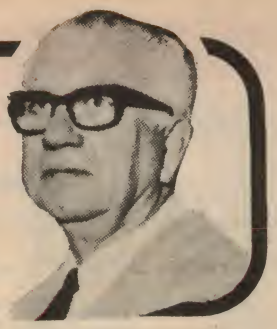
SYDNEY: 400 Kent St., Sydney, 29 1005. 657 Pittwater Rd., Dee Why, 982 9790. **BRISBANE:** 293 St.Paul's Tce. Fortitude Valley, 52 8391. **MELBOURNE:** 985 Whitehorse Rd., Box Hill, 89 8371. **PERTH:** 557 Wellington St., Perth (Opp. new bus terminal), 21 3047.

HOW TO ORDER:

MAIL ORDERS: PRINT **all** details clearly. Include phone no. for quick checking if any problems. Send cheque or postal order (NOT cash) to Kitsets (Aust.) Pty. Limited, PO Box 176 Dee Why 2099. For urgent queries or PMG/COD ring us on 982 7500, Area code 02 (24 hour open line service).

The Amateur Bands

by Pierce Healy, VK2APQ



Amateur radio club directory

An important role that radio clubs can play is publicising amateur radio and its worth to the community; a role which cannot be emphasised too strongly. The record number of clubs listed in this year's directory suggests that there should be plenty of opportunities for this type of public relations.

The fellowship which amateur radio fosters can be judged by the number of clubs which exist. Not only do they provide a venue for personal contact between these with a common interest, but also an avenue through which amateur radio can be brought to the notice of the general public.This latter aspect must be pursued with vigor if the status of amateur radio is to be preserved.

In 1979, at Geneva, the International Telecommunication Union will be holding the World Administrative Radio Conference. At this conference all radio frequency allocations will be under review. As this will include all amateur bands, it is up to all amateurs to support their national societies.

One of the policies emphasised at the International Amateur Radio Union, Region III Association conference earlier this year was: to provide better communications between societies and administrations. This policy can be initiated at the radio club level by members projecting a good image of amateur radio within their local communities.

An example of this type of activity is given in a report from Sam Voron, VK2BVS, publicity officer of the University of New South Wales Amateur Radio Society.

"As part of a campaign to show students what amateur radio is, UNSWARS members have been operating a station and information stand on the Unversity library lawns each Monday from 1 to 3 pm.

"In addition the group provided a demonstration to the students and staff at the North Randwick High School.

"Also, during the local Orange Festival celebrations, at the invitation of the Mayor, the group combined with the Crestwood Radio Club to set up an amateur station outside one of the major chain stores in the Baulkham Hills shopping centre."

This year's listing of amateur radio clubs is substantially larger than in previous years. In addition there is a listing of some of the major amateur radio societies in the world. These may be of general interest but in particular to those fortunate enough to be travelling overseas.

INTERNATIONAL SOCIETIES

International Amateur Union—c/- 225 Main Street, Newington, Connecticut, USA.

American Radio Relay League—225 Main Street, Newington, Connecticut, USA.

Radio Society of Great Britain—35 Doughty Street, London, England.

New Zealand Association of Radio Transmitters—Box 1459, Christchurch, New Zealand.

Radio Sports Federation of USSR—Box 88, Moscow, USSR.

Japan Amateur Radio League—Box 377, Tokyo, Central Japan.

Federation of Amateur Radio Societies of India—4 Kurla Industrial Estate, Ghatkopar, Bombay, India.

Wireless Institute of Australia—Federal Executive, PO Box 150, Toorak, Melbourne, Victoria 3142.

Australian Capital Territory Division—PO Box 1173, Canberra City, ACT 2601.

New South Wales Division—Wireless Institute Centre, 14 Atchison Street, Crows Nest, NSW 2065.

Victorian Division—412 Brunswick Street, Fitzroy 3062.

Queensland Division—GPO Box 638, Brisbane 4001.

South Australia Division—GPO Box 1234K, Adelaide 5001.

Western Australia Division—GPO Box N1002, Perth 6001.

Tasmanian Division—GPO Box 869J, Hobart 7001.

AUSTRALIAN RADIO CLUBS

Name: Sydney Chapter—Quarter Century Wireless Association.
Membership: Holders of an amateur licence for 25 years or more.
Meeting place: North Sydney Anzac Memorial Club. Anzac Street, Cammeray.
Day and time: 2nd Wednesday of each month at 7.00pm.
Affiliation: Quarter Century Wireless Association, USA.
Net frequency: 147.2MHz.
Contact: President, Harry Caldecott, VK2DA; Secretary, Pierce Healy, VK2APQ; Treasurer, Eric Bierre, VK2BEK; at their call book addresses.

Name: Hunter Branch NSW Division WIA.
Club call sign: VK2AWX; repeater VK2RAN.
Meeting place: Newcastle Technical college, and Northumberland Radio Centre Teralba.
Day and time: 1st Friday of each month at NTC and 3rd Friday each month at NRC at 8.00pm.
Affiliation: NSW Division WIA.
Net frequency: 3570kHz each Monday evening at 7.30pm.
Contact: Secretary, Ray Leben, PO Box 134, Charlestown. Bill Hall, VK2XT, Telephone 59 1586.

Name: Blue Mountains Branch NSW Div. WIA.
Club call sign: VK2AUX.
Meeting place: Springwood Public School, Barns Road, Springwood.
Day and time: 2nd Friday each month at 8.00pm.
Affiliation: WIA and YRCS.
Net frequency: 52.2MHz.
Contact: Roy Lopez, VK2BRL Telephone (047) 54 1394.

Name: Illawarra Amateur Radio Society.
Club call sign: VK2AMW.
Meeting place: Wollongong Town Hall Committee room.
Day and time: 2nd Monday of each month at 7.30pm.
Affiliation: NSW Division WIA.
Net frequency: Channel 6 repeater and 432MHz moonbounce.
Contact: Secretary, Ian Bowmaker, VK2ZJA, PO Box 110 Dapto, NSW 2530. Telephone 29 2158.

Name: Westlakes Radio Club.
Club call sign: VK2ATZ.
Meeting place: Clubrooms, York Street, Teralba.
Day and time: Saturday afternoons and Wednesday evenings at 7.30pm.
Affiliation: NSW Div. WIA and YRCS.
Net frequency: Not stated.
Contact: Eric Brockbank, VK2ZOP, PO Box 1, Teralba 2284. Club telephone (049) 58 1588.

Name: Wagga District Radio Club.
Club call sign: VK2WG.
Meeting place: Civil Defence Headquarters Cnr. Peter and Morrow Streets, Wagga Wagga.
Day and time: Last Monday of each month at 8.00pm.
Affiliation: NSW division WIA.
Net frequency: 7100kHz and 146MHz.
Contact: Sid Ward, VK2SW, telephone 22 6082.

Name: University of NSW Amateur Radio Society.
Club call sign: VK2BUV.
Meeting place: Room 601, top floor Electrical Engineering building, on campus or Stage III building, 2nd floor.
Day and time: Lunch time each day. General meeting every three weeks.
Affiliation: WIA and YRCS.
Net frequency: 27.125MHz CW; AM and SSB.
Contact: Sam Voron, VK2BVS, 2 Griffith Avenue, East Roseville 2069. Telephone 407 1066.

Name: Sydney University Amateur Radio Club.
Club call sign: VK2BSU.
Meeting place: Sydney University.
Day and time: Weekly during term at 1.00pm.
Affiliation: Nil.
Net frequency: Nil.
Contact: Jeff Pages, VK2BYY. Telephone 649 9829.

Name: Central Coast Amateur Radio Club.
Club call sign: VK2AFY; repeater VK2RAG.
Meeting place: Club rooms Dandaloo Street, Kariong.
Day and time: 1st and 3rd Friday of each month at 8.00pm.
Affiliation: NSW division WIA.
Net frequency: Not stated.
Contact: Postal address, PO Box 238, Gosford, NSW 2250.

Name: Maitland Radio Club.
Club call sign: VK2BHV and VK2ZVM.
Meeting place: Clubrooms, 1 Maize Street, Tenambit.
Day and time: Friday evenings at 7.00pm.
Affiliation: WIA.
Net frequency: 146.00MHz FM.
Contact: Secretary, A. Watson, PO Box 59, East Maitland, NSW 2323. Telephone 37 2282. Club telephone 33 5680.

Name: The St. George Amateur Radio Society.
Club call sign: VK2LE.
Meeting place: Rockdale Civil Defence Headquarters.
Day and time: 1st Wednesday of each month at 7.30 p.m.
Affiliation: WIA NSW division.
Net frequency: 14.1MHz Tuesdays at 8.00pm.

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown 2200.

AMATEUR BANDS

Contact: St. George Amateur Radio Society, PO Box 77, Penshurst, NSW 2222.

Name: Orange and District Amateur Radio Society.
Club call sign: VK2AOA.
Meeting place: Cnr. Peisley and Byng Streets, Orange.
Day and time: 2nd and 4th Friday each month at 8.00 p.m.
Affiliation: NSW division WIA.
Net frequency: Orange repeater VK2AOA/R1.
Contact: Robert Alford, VK2ZRJ. Telephone 62 4673. Allan Wright, VK2BVL. Telephone 62 1432.

Name: Parkes and District Radio Club.
Club call sign: VK2BPK.
Meeting place: 2nd Parkes Scout Hall.
Day and time: Each Wednesday evening at 7.30 pm.
Affiliation: Not stated.
Net frequency: Channel 1 Orange repeater.
Contact: Kim Stevens, VK2ASY, PO Box 371, Parkes NSW 2870. Telephone 62 3455, 63 3200 (AH).

Name: Oxley Region Radio Club.
Club call sign: VK2BOR.
Meeting place: Members' homes as convenient.
Day and time: As convenient to members.
Affiliation: WIA.
Net frequency: 2 metres FM channel 40.
Contact: Club president Peter Alexander, VK2PA, telephone Port Macquarie (065) 83 2033, business hours.

Name: CAMTEC.
Club call sign: VK2BCT.
Meeting place: "The Grange", Mt. Victoria, NSW.
Date and time: Three one week residential camps each January.
Affiliation: YRCS, NSW.
Contact: Mr J. Wightman, 10/37 Eddystone Road, Bexley, NSW.

Name: Western Suburbs Radio Club.
Club call sign: Not stated.
Meeting place: Scout Hall, Cnr. Kenyons and Fowler Roads, Merrylands.
Day and time: 2nd and 4th Tuesday of each month at 8.00pm.
Affiliation: Nil.
Net frequency: Nil.
Contact: Athol Tilley, VK2ZYT, 6 Belmore Street, Villawood, NSW. Telephone 72 1107.

Name: Canberra YMCA Radio Club.
Club call sign: VK1YR.
Meeting place: Coroborree Park Youth Centre.
Day and time: Sundays at 2.00pm to 5.00pm.
Affiliation: YMCA.
Net frequency: Nil.
Contact: Secretary, PO Box 33, Hughes, ACT 2605.

Name: WIA Eastern Zone.
Club call sign: VK3BEZ. Repeaters VK3RGL and VK3RLV.
Meeting place: Gippsland Institute of Advanced Education, Churchill.
Day and time: No set dates.
Affiliation: Victorian Division WIA.
Net frequency: 3650kHz each Sunday at 8.30pm.
Contact: Bruce Hocking, Vk3ADB, 45 Wallace Street, Morwell 3840. Telephone 34 2718.

Name: Geelong Amateur Radio-TV Club.
Club call sign: VK3ATL/T.
Meeting place: Clubrooms Storrer Street, East Geelong.
Day and time: Each Friday evening at 8.00pm.
Affiliation: Victorian Division WIA.
Net frequency: Two metre FM channels B (40) or repeater VK3RGL (4).
Contact: President Mike Trickett, VK3ASQ, telephone 78 1886 or Secretary David Mann, VK3ZMZ, telephone 9 4261.

Name: Eastern and Mountain District Radio Club.
Club call sign: VK3ER; VK3BNW (Nunawading Branch).
Meeting place: General meetings, Mooroolbark Technical School, Reay Road, Mooroolbark. Nunawading Branch, at the Coffee Shop, Nunawading Civic Centre.
Day and time: Last Friday of the month at 8.00pm and second Friday of the month at 8.00pm, respectively.
Affiliation: Victorian Division WIA.
Net frequency: 3660kHz each Monday at 8.00pm. 146MHz each Monday at 8.30 pm. No branch net at present.
Contact: The secretary, PO Box 87, Mitcham, Vic. 3132.

Name: The Moorabbin and District Radio Club.
Club call sign: VK3APC.
Meeting place: Moorabbin Baseball Rooms, Summit Avenue, Moorabbin.
Day and time: 1st, 2nd and 3rd Fridays of each month at 8.00pm.
Affiliation: Victorian Division WIA.
Net frequency: Nil.
Contact: The Secretary, PO Box 88, East Bentleigh, Vic. 3165.

Name: Western Suburbs Radio Club.
Club call sign: WK3AWS.
Meeting place: The recreation rooms, Melbourne Caravan Park, 265 Elizabeth Street, Coburg.
Day and time: 1st and 3rd Fridays of each month, 8.00pm.
Affiliation: Victorian Division WIA.
Net frequency: 146.65MHz FM.
Contact: Dave Hunt, VK3YBX, 1 Courtnay Place, Epping 3076. Telephone 401 1463.

Name: Swan Hill District Radio Club.
Club call sign: VK3BSH
Meeting place: Swan Hill Technical School, Room 13.
Day and time: First Thursday of each month at 8.00 pm. School holidays excepted.
Affiliation: Victorian Division WIA.
Net frequency: Channel 3 repeater VK3RSH.
Contact: Secretary E.S. Day, VK3YHN, PO Box 682, Swan Hill 3585. Telephone (050) 32 4298.

Name: Warrnambool Amateur Radio Club.
Club call sign: Applied for.
Meeting place: Buffalo Lodge Hall, Warrnambool.
Day and time: 2nd Wednesday of each month.
Affiliation: Not stated.
Net frequency: Not stated.
Contact: D. Beven, President, Princes Highway, Warrnambool.

Name: Townsville Amateur Radio Club.
Club call sign: VK4WIT. Repeater VK4RAT.
Meeting place: Civil Defence Headquarters.
Day and time: Thursday evenings at 7.30pm.
Affiliation: Queensland Division WIA.
Net frequency: 3605kHz each Sunday evening at 7.45 pm.
Contact: Peer Renton, VK4PV, PO Box 964, Townsville, Qld. 4810.

Name: Cairns Amateur Radio Club.
Club call sign: VK4HM.
Meeting place: Civil Defence Headquarters, McNamara Street, Cairns.
Day and time: 2nd Wednesday of each month at 8.00pm also each Sunday morning.
Affiliation: Queensland Division WIA.
Net frequency: 3605kHz each Sunday evening at 7.45pm.
Contact: John Roberts, VK4TL, telephone 51 2244 (bus) or 55 4430 (priv).

Name: Gold Coast Radio Club.
Club call sign: VK4WIG.
Meeting place: Currumbin CWA Hall.
Day and time: 2nd Friday of each month at 8.00pm.
Affiliation: Queensland Division WIA.
Net frequency: 3650kHz each Sunday evening at 8.00pm.
Contact: John Adams, VK4UI, telephone 38 3406. Postal address PO Box 588 Southport 4215.

Name: Mackay Amateur Radio Club.
Club call sign: VK4WIM.
Meeting place: 13 Boundry Road, Mackay.
Day and time: 4th Friday of each month at 7.30pm.
Affiliation: Not stated.
Net frequency: Not stated.
Contact: Richie Chappel, VK4RR, telephone 59 0236 or write to MARC, PO Box 1065, Mackay Qld 4740.

Name: Sacred Heart College Radio Club.
Club call sign: VK5FZ.
Meeting place: SHC, Brighton Road, Summerton Park, SA.
Day and time: Each Friday at 7.00pm.
Affiliation: YRCS SA.
Net frequency: 3530kHz CW; 53.1MHz AM; 146 MHz FM.
Contact: Leo Powning, VK5ZLO. Telephone 298 1632 or Michael Kelly, 6 Panton Cresent, Somerton Park 5044 SA.

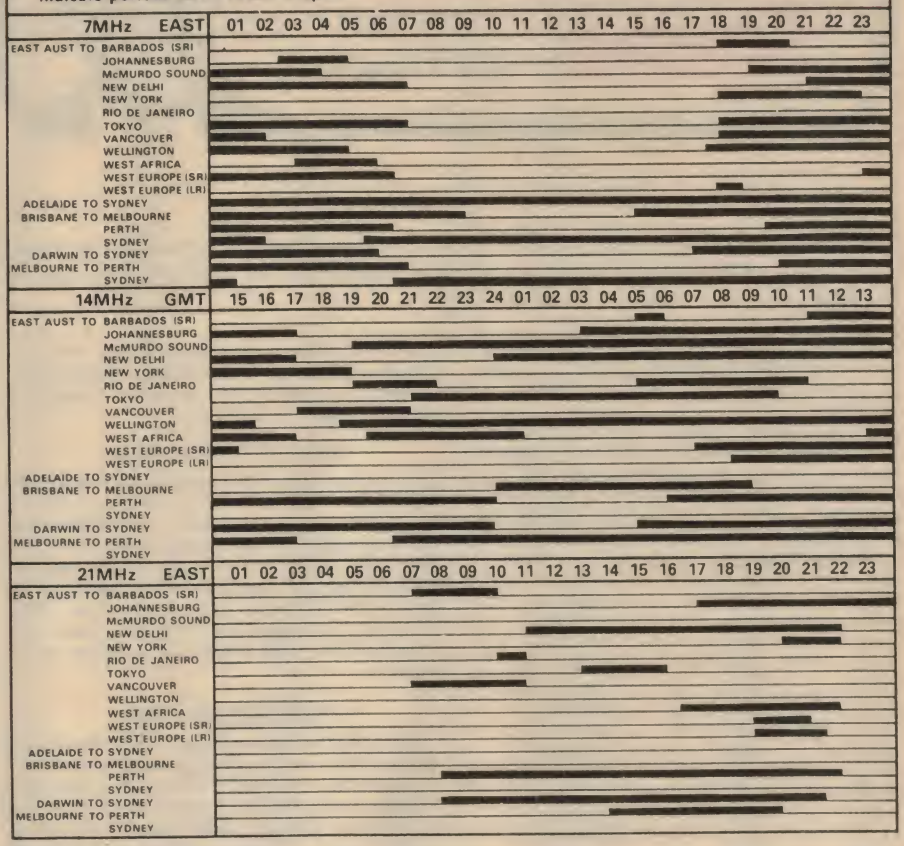
Name: The West Australian VHF Group Inc.
Club call sign: VK6RTV 145.00MHz beacon, and VK6WH.
Meeting place: Club rooms Wireless Hill.
Day and time: 4th Monday in each month at 8.00pm.
Affiliation: Not stated.
Net frequency: Not stated.
Contact: Secretary Tom Berg, VK6ZAF, PO Box 189, Applecross, WA 6153. (092) 39 3614.

Name: Darwin Amateur Radio Club.
Club call sign: VK8DA.
Meeting place: Club house Bishop Street, Darwin.
Day and time: 1st Monday each month at 7.30pm.
Affiliation: South Australian Division WIA.
Net frequency: 146.00MHz.
Contact: President Terry Hine. Telephone 81 2769.

Name: DX Group.
Aim: To foster the hobby of long distance radio listening and DX amateur radio communication.
President: Neil Stollznow.
Meetings: First Friday of each month, Wireless Institute Centre, 14 Atchison Street, Crows Nest, at 7.30pm.
Contact: Roger Browne, VK2BEQ, publicity officer, 18A Bradleys Head Road, Mosman NSW 2088.

IONOSPHERIC PREDICTIONS FOR DECEMBER

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. 12.75



WOLLONGONG REPEATER

The Wollongong channel 6 repeater (146.25MHz in 146.85MHz out) was installed at Robertson in mid-September. Both transmit and receive aerials are dipoles; vertically polarised. The receiver dipole is on a four metre mast next to the receiver at the top of a hill. The transmitter dipole is on the slope of the hill on the north-east side on a 25 metre mast. Both aerials are in approximately the same horizontal plane but separated by 400 metres.

The equipment is basically a 5 watt solid state unit operated from a 12 volt battery which is continuously charged. The transmitter output is fed to the aerial via a commercially made 90 watt amplifier, powered from the AC mains. It uses a QQE07/50 valve. The amplifier has been modified so that in the event of a power failure, very common at Robertson, the exciter output is fed directly to the aerial. The repeater will then run at 5 watts output from the battery until mains power is restored.

The repeater is housed in a weatherproof cubicle at the base of the transmitter mast, except the receiver, which is on top of the hill and connected to the control unit by 400 metres of underground two-core cable.

Audio and noise is fed down the cable to the control unit and DC is fed up the same cable to power the receiver. This system keeps the amount of electronics on the hilltop to a minimum and allows muting and audio level controls to be located near the transmitter, in a more accessible location.

All timers are adjustable and at present the noise burst is set at half a second, time-out is 4 minutes, failsafe time is 10 minutes, and the identification unit will operate every 5 minutes while the repeater is in use. The identification unit can be switched to key the transmitter as a beacon if required.

The solid state section of the repeater was designed and built by Graeme Dowse, VK2AGV and Hank Laauw, VK2BHL. The transmitter uses direct crystal modulation, and no audio processing is used except for a clipper which prevents over-deviation on excessive audio peaks. The audio response is limited mainly by the 600 ohm transformers at each end of the land line.

There is no RF stage in the receiver, but instead a pair of BFR 91 UHF transistors in a low noise balanced mixer. There are two 10.7MHz IF filters and two stages of gain at 10.7MHz before conversion to 455Hz. The limiter and detector is an AWM1306 IC. A single stage balanced amplifier feeds the discriminator ouput signals to the landline.

Sensitivity is comparable to that of similar commercial units, giving 20dB quieting for less than 0.4uV input. This is considerably better than the previous repeater. Because of the good cross-modulation performance it was found unnecessary to use co-axial filters, thus eliminating the temperature stability problem encountered with the previous repeater.

Shortwave Scene

by Arthur Cushen, MBE

This month, the new relay station of Radio Australia at Carnarvon in West Australia is scheduled to open using one transmitter of 250kW and one of 100kW.

The devastation of Cyclone Tracy last year caused the destruction of the Radio Australia relay station at Darwin, putting the four 250kW transmitters out of action.

The Australian Government has moved quickly to replace this loss, and on December 20 at Carnarvon, in northern Western Australia, a new relay station will be opened. The tentative schedule of the relay station, which will beam programs to Asia, shows that frequencies from 6 to 15MHz will be used for the initial programming.

kHz	kW	GMT
6015	100	1100-1500
6075	250	2045-2230
6170	250	1430-1730
7240	100	2030-2230
7260	100	1500-1730
9560	100	2230-0030
9570	250	1030-1430
9700	250	2230-0030
9730	100	0800-1100
11770	250	0030-0300
11810	100	0030-0300
11935	250	0830-1030
15190	250	0300-0830
15415	250	0300-0800

FINLAND FREQUENCY CHANGE

The Finnish Broadcasting Company at Helsinki has advised that during our summer months they will be using some new frequencies to try to improve reception in various areas of the world. The daily broadcast in English from 0300-0330GMT has been moved from 9550kHz to 9720kHz. The broadcast from 0730-0800GMT (heard on Sundays half an hour later) is now carried on 6120kHz, which replaces 6145kHz. Other programs in English are from 1400-1430GMT on 1518kHz, 1830-1900GMT on 11755kHz and 2030-2100GMT on 6120kHz.

At the present time, new high-powered transmitters are being installed at Pori, together with new aerial systems. By next September, the station should be operating with one transmitter of 250kW, one of 100kW and two of 15kW.

THE VOICE OF GREECE

A new slogan now being heard from Athens is the "Voice of Greece", which replaces the former Hellenic National Radio and Television Institute. According to the latest schedule, an expansion of short-wave services has been made. Several new languages have been introduced and a transmission to North America is being received on 9520kHz at 1200 hours GMT. The program consists of Greek at 1200GMT, English at 1215GMT and French from 1230-1245GMT.

The reception of Athens on Sundays with a relay of a church service on 9710kHz has been noted at 0600GMT. In this area at 0630GMT there is severe sideband from the Radio Nederland relay station on Bonaire. According to Bob Padula of Melbourne his reception has been fair, but the station suffers interference from Radio South Africa.

MUSCAT AND OMAN

According to the BBC Monitoring Service, the test transmissions carried out from Muscat appear to have ended and the transmitter on 11890kHz has come into regular service carrying the domestic service. It operates from 1400-2210GMT and program previews give the significant items broadcast as: 1600-1625GMT, news and commentary; 1700-1710GMT, local news; 1900-1920GMT, news; and 2130-2145GMT, news review. All programs are in Arabic.

INDONESIAN VISIT

Two active Melbourne listeners, David Foster and Michael Willis, are to visit Indonesia, Malaysia and Singapore for two months. During that time they will take a close look at all aspects of broadcasting in Indonesia, which for many readers is an area of intense interest, with rapid progress in all forms of broadcasting and the introduction of more medium-wave stations.

David Foster has recently confirmed reception of RRI Tanjung Pinang, which verified reception of 4945kHz. In addition, the station operates on the medium-wave frequency of 1189kHz with an output power of 5kW. The current medium-wave schedule is 0900-1515GMT and 2300-0100GMT on weekdays, and 0900-1515GMT and 0000-0300GMT on Sundays and holidays. The daily shortwave schedule on 4945kHz is 2300-0100GMT using 1kW, 0500-0715 using 150W, and 0900-1200GMT using 1kW.

NEW ALL-NIGHT COLOMBIAN

A new 24 hour-a-day Colombian has been heard on 4785kHz carrying the programs of Radio Super. The station is Ecos del Combeima and broadcast from Ibaque. Reception has been best around 0730GMT. The station makes frequent reference to Radio Super and every 30mins gives its own call signs and frequencies of operation (710kHz medium-wave and 4785kHz short-wave). The address of the station is Aereo 11-87, Ibaque, Colombia.

RADIO SAMOA VERIFIES

A new slogan on medium-wave is from Radio Samoa which announces as 'Your news and music station for the South Pacific, 1120 on your radio dial 24 hours a day'. The station has confirmed our reception, but draws attention to the fact that they still use the call-sign WVUV on their letterhead and so cannot be classed as a new station.

Stringent measures have forced the American Government to lease out WVUV to Hawaiian broadcasting magnate Lawrence S. Berger, who has a 30-year lease on the station with the right to purchase the station after 4 years for $200,000. The station was costing the US Government $US65,000 a year to run. The FCC turned down several objections to the transfer to private commercial control, and commented that favourable consideration would be given to applications for 2 or 3 more stations on AM as there was 'plenty of room to spare along the dial' and more stations could be in the public interest.

Radio Samoa operates on 1120kHz with 10kW power, and is on the air 24 hours a day. It is affiliated with the American CBS network. The address of the station is Radio Samoa Incorporated, PO Box 280, Pago Pago, American Samoa, 96799.

ASIAN SURVEY

In the December issue of Down Under DX News, the third issue to be published, a survey of stations between 4000-4750kHz will be included, with all stations heard in this out-of-band region listed. An additional survey covers 5950 to 6200kHz, with only Asian stations being included in this review. The publication also includes general DX news from Asia and can be obtained for 2IRC's or 30c in Australian stamps from David Foster, 17 Stevenson Street, Kew, Victoria, Australia 3101.

LISTENING BRIEFS

AFRICA

MAURITIUS: According to "Sweden Calling DXers", a new transmitter of 250kW is being installed and will operate 24 hours a day. The proposed frequency of operation is 7200kHz.

TANZANIA: Radio Tanzania is now using 15435kHz and has been heard at 1915GMT with English commentary. Reception is spoilt in this area by AFRS on 15430 and WYFR on 15440kHz.

TUNISIA: The Arabic service is now heard on 9650kHz up to 1800GMT. According to the BBC Monitoring Service, a frequency change is then made to 7225kHz. This appears to be a new transmitter as its operation is still on an irregular basis.

ALGERIA: Radio Algier broadcasts to Europe in French with two transmissions each day—0600-0800GMT and 1800-2400GMT. Both transmissions are broadcast on 7245kHz and 11940kHz.

ASIA

INDIA: All India Radio has been heard by Michael Stevenson of Harden, NSW, on 11770kHz. Reception has been at 0030GMT when a broadcast in English was presented. This was followed by Indian music.

ISRAEL: Bob Padula of Melbourne advises reception of the Home Service Relay of the Israel Broadcasting Authority in Jerusalem. This transmission is now noted at the earlier sign-on time of 0355GMT on 9400, 12045 and 12080kHz. The Overseas Service in English has also been observed between 0500-0515GMT on the frequency of 17690kHz beamed to Australasia. Parallel channels also observed were 7395, 9009, 9815, 11643 and 15238kHz.

QATAR: The shortwave service, which operates on 9570kHz with 100kW, is now operating 0300-0700GMT and 1000-2100GMT, except on Friday when the transmission is continuous from 0300-2100GMT. All the programs are in Arabic.

DUBAI: The shortwave transmission from Dubai, which has been off the air for some months, has returned to 6040kHz. The station has been heard with Arabic programs at 1800GMT.

PAKISTAN: Radio Pakistan has made frequency changes for its two transmissions to the Australasian area. The broadcast from 0230-0245GMT is now carried on 17830 and 21590kHz, while the transmission from 2345-0045GMT is now broadcast on 9460, 11672 and 15205kHz.

AMERICAS

PARAGUAY: Radio Nacional has been heard at 1000GMT on 6025kHz with full station announcement in Spanish, according to "Tropical DX". This frequency is a slight move from the frequency of 6015kHz on which Radio Nacional operated for several years.

VENEZUELA: Radio Los Andes, operating on 6010kHz, has been heard with an opening announcement at 1042GMT. The call sign of the station is YVSB, and it is located in Merida, Venezuela.

GUYANA: Action Radio on 3290kHz now opens at 0730GMT after a tuning signal, according to Ray Crawford of Invercargill. The station suffers interference from Port Moresby, which is on the same frequency, after 0800GMT.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT, add 9 hours for West Aust. Summer time, 11 hours for East Aust. Summer time and 13 hours for NZ Summer time.

SOCKET SPANNER SET

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TUNING UNIT

TU Series. With 2 condensors. Coarse & fine tuning. (Suit aerial coupling.) 19" rack mounting and chassis, etc.
ONLY $9.50 ea.
Post A. $2.20, B. $3.50, C. $3.20, D. $3.95.

P.M.G. TYPE TELEPHONES

Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

$29.50
(2 TELEPHONE SETS)

$1 cartage to rail. Freight payable at nearest attended railway station.

ALTIMETERS

Sensitive type ex Air-Force, made by Pioneer USA. $37.50.
Post: A. $1.70, B. $2.25, C. $2.40, D. $2.65.

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MINIATURE ELECTRIC MOTORS

1½ to 3 volts DC. Ideal for model boats, cars, planes, etc. Strong torque. Only
75c each or 10 for $5
P & P 40c ea. or 10 for $1.10.

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Post A. $1.30, B. $2.00, C. $2.80, D. $2.80.

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$60

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MORSE KEY $1.40 Post 40c. | **MORSE KEY BUZZERS** $4.25 Post 60c.

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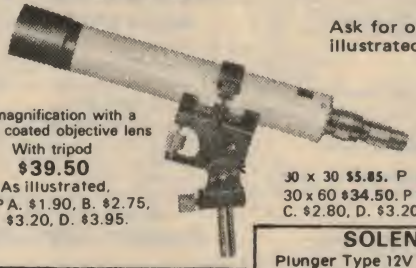

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INFORMATION CENTRE

PLAYMASTER 143: May I have some information on the Playmaster 143? What happens when the output is shorted apart from the fuses blowing? What happens when the output is left open? Is the input of the volume control and the output of the preamp very affected by circuitry of slightly different impedances? Would an auxiliary switchable output for mains along the transformer side of the amp. introduce much hum, particularly to the power amps? At what frequency would a rumble filter be most effective at 12dB/octave? Your magazine is by far the best, as long as you keep those projects coming! (F. F. E., Belrose, NSW).

• Thank you for your comments about the magazine; we do try to present interesting and useful projects. The exact effect of a short applied to the output of the PM 143 is a little difficult to predict, as it depends on the output voltage at the time the short is applied. We do not recommend that it should be shorted, as damage to the output transistors may result. On the other hand, an open circuit is quite permissible, and will generally have no ill effect.

The volume control input and the preamplifier output should not be affected by slightly different impedances, although large changes would have some effects. We are unable to say whether the 240V AC switched outputs such as you envisage would introduce extra hum into the amplifier, this would have to be determined experimentally. The turnover frequency of a rumble filter should be determined by a number of factors, including the frequencies of the rumble, and the types of signals to be processed, so we are unable to nominate a particular frequency.

AC ELECTRIC TRAINS: I have just become interested in model railways as a second hobby (to electronics), so I unpacked my old train set which I acquired some years ago to find that the transformer was broken. I had read about your inertia train control in the May 1974 issue of EA, and so rather than fix mine or buy a new one I thought that I would build a similar one to that described in the magazine.

After studying the article diligently and adding a few modifications to fit my MARKLIN set (German), I found that my old transformer had no rectifier, i.e., the train ran on AC.

Would I be able to run my train on DC if I built your train control, also electric signals and points? If not, how about designing an inertia control for my brand of set and publishing it in EA? Congratulations on a fine magazine. (P. E., Haberfield, N.S.W.)

• Thank you for your appreciation of the magazine. In all probability your loco is fitted with a universal type motor, and it is possible to run such motors on DC. However, a characteristic of this type of motor is that it is impossible to reverse it in the normal fashion, by reversing the polarity of the rail voltage.

There will probably be a switch or pulse-operated relay fitted to the loco to reverse the current through the field independently of the current through the armature. This is the only way of reversing the train when powered by AC.

When a DC power supply is used there are two ways to modify the motor so that it can be reversed by reversing the supply polarity. The first way is to simply remove the wound field, and substitute a permanent magnet, if this is physically possible. The second method is to supply the field from a bridge rectifier, so that irrespective of the supply polarity, the field current, and hence the field itself, will always have the same direction. (Refer "EA" May 1975, P81)

Assuming that the motor can be modified in this way, and that its voltage requirements are similar to that provided by the controller, then the Inertia Train Control featured in the May 1974 issue should be quite satisfactory.

We are unable to say whether or not your signals and points will operate from DC instead of AC, as this will depend on their mode of operation. However, if they are impulse types, then they should operate on either type of supply equally well. For details of how to use these types of signals with the Inertia Train Control, we suggest you read the article "Signal System for Train Controller", in the November 1974 issue (File No. 2/MC/12).

As AC powered trains are not in common use any more, due to the difficulties of reversing the loco, there is very little call for an inertia controller to be used with them. Happily, it is often possible to convert these types to DC operation.

DEAD LETTERS: We are holding two orders, both for handbooks, which carry no sender's name or address. One carried the postmark "Manly Qld", and the other is from Hong Kong. If the writers will confirm their original order and supply their full address, we will complete the order.

DIGITAL ALARM CLOCK: Firstly, congratulations on a magazine that keeps me and my fellow readers well abreast of what's going on in constructional and theoretical electronics and hi-fi. Secondly, I have just recently completed construction of your Digital Alarm Clock (December, 1974), and I have a couple of queries which I hope you can throw some light on.

The AM/FM indicator on the Sperry readout remains flashing during normal operation and while operating the fast/slow toggle. Is this a fault with the clock chip? Also, the clock chip tends to become rather hot after ten to fifteen minutes' operation, and the transformer is fairly hot after approximately half an hour. Is this normal with this type of IC?

Otherwise I am very pleased with all the other functions of the clock which work perfectly. (R.J., Melbourne, Vic.)

• We are pleased to see that you find the magazine interesting and informative, R.J. The temperature rises that you have noticed in the transformer and the clock chip itself are quite normal, and are no cause for concern. The flashing AM/FM sign is intended to warn of a power failure. An internal flip-flop is triggered when the voltage on pin 29, Vss, falls below a preset level.

This preset level, which is constant for a particular chip, can vary from 9V to 20V from chip to chip. From your description of the operation of your clock, it appears that in your clock chip, this preset level is higher than the Vss voltage, causing the power supply failure indicator to operate at all times.

Unfortunately, there is little which can be done about this, apart from replacing the clock chip itself. A possible cure, however, is to reduce the loading on the transformer in the hope that the Vss rail voltage will rise sufficiently to exceed the preset level of the power failure detect voltage. This can be done by decreasing the display brightness, using the trimpots provided for this purpose.

PLAYMASTER CASSETTE DECK: Since the addendum to the articles on the Playmaster Stereo Cassette Deck in the January '75 issue of "Electronics Australia", I have been puzzled by the connections of the frequency compensation components in the record and playback amplifiers. They are wired between pins 3 and 12 of the op amps. Yet in the diagrams on page 37 of the October '74 issue, pin 12 of the 14 lead DIP is NC. If this pin is really NC, then why is it treated as an active terminal or if it is an active terminal why is it marked NC? (E.E., Albury, NSW).

• You are confusing the 741 op amp featured in the original circuit as published in October '74 with the modified circuitry using 709 op amps. As noted in the January '75 article, the 709 is a drop-in replacement for the 741 as far as inputs and outputs are concerned but the whole point of using the 709 was that it has provision for external frequency compensation components (whereas the 741 has not). Therefore, some of the pins which are unused in the 741 are used in the 709.

COURSES IN ELECTRONICS: I hope that you will be able to advise me. I wish to do an electronics course so that I can dabble in building the various projects that are on the market, as advertised in your magazine, and even design simple radios, etc., as a hobby.

My problem is time, as I am studying Mechanical Engineering Certificate Stage II four nights per week and in most of my spare time. I am used to going to classes at night, and have done so for quite a number of years as this style of study suits me. Correspondence course instruction, on the other hand, doesn't suit me.

What I would really like is about a 10 week course of say 4 or 5 nights per week during the break between the end of tech this year and the beginning

If you are unable to complete an "Electronics Australia" project because you missed out on your regular issue, we can usually provide emergency assistance on the following basis:

PHOTOSTAT COPIES: $2 per project, or $2 per part where a project spreads over multiple issues. Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries.

METALWORK DYELINES: Available for most projects at $2 each, showing dimensions, holes, cutouts, etc., but no wiring details.

PRINTED BOARD PATTERNS: Dyeline transparencies, actual size but of limited contrast: $2. Specify positive or negative. We do not sell PC boards.

REPLIES BY POST: Limited to advice concerning projects published within the past 2 years. Charge $2. We cannot provide lengthy answers, undertake special research or discuss design changes.

BACK NUMBERS: Only as available. Within last 6 months, face value. 7-12 months, add 5c surcharge; 13 months or older, add 10c surcharge. Post and packing for 60c per issue extra.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee, for reply in the magazine, at the discretion of the Editor.

COMMERCIAL, SURPLUS EQUIPMENT: No information can be supplied.

COMPONENTS: We do not deal in electronic components. Prices, specifications, etc., should be sought from advertisers or agents.

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

INFORMATION CENTRE

of tech next year. I envisage a course covering both the theoretical and practical aspects of electronics. Are you able to offer advice as to a suitable course? (K.D., Asquith, NSW).

● Unfortunately K.D. we are unaware of any courses in electronics along the lines you envisage. The points raised in your letter (which we have condensed somewhat) have been raised by enthusiasts many times in the past and, in fact, were the subject of the Forum column in the November, 1974 issue.

We appreciate, though, that yours is a special case, as your present commitments preclude you from taking the usual technical college courses. In these circumstances, you really have no choice but to undertake correspondence courses or some other course of home study.

For example, our own handbooks "Basic Electronics" and "Fundamentals of Solid State" have been written specifically for the purpose of self instruction, and would serve as a suitable introduction to the theoretical aspects of electronics. In addition, the first mentioned publication describes several simple projects which may be built in order to gain practical experience. Projects of a similar nature are also regularly described in "Electronics Australia".

Alternatively, you may care to enrol for a correspondence course and aim for some specific goal. For example, the Wireless Institute of Australia (WIA) conducts a course leading to the award of the Amateur Operators Certificate of Proficiency (AOCP). A course such as this will give you a basic general grounding in electronics, even if you are not interested in the ultimate goal of the course.

Although you say that home study courses do not suit you, we find it difficult to sympathise. Really, there is only one way to gain knowledge—hard work! And with the two alternatives listed above, you will be able to study at your own pace.

Apart from this, about the only other suggestion we can make is that you write to the Department of Technical Education. Perhaps they have a suitable course to offer which we have yet to hear about. On a similar theme, a student counsellor at your technical college may be able to offer further advice.

TV BOOSTER: In Circuit & Design Ideas for March, 1975, you featured a circuit for a TV Booster. Could you tell me over what distance this amplifier is capable of working? Living approximately 180 miles from the stations of interest, I have tested the circuit with a forty foot high aerial without any luck. If this distance is too great for the amplifier, is it possible to add extra stages to the amplifier without affecting the frequency, but increasing the gain? If this is not feasible, is there another circuit available which would meet my requirements? (B.A. Whyalla Stuart, SA.)

● From the questions you have asked B.A., there are some points which must be clarified. The distance over which any booster amplifier will work is determined by other more important factors. Firstly, there must be a signal at the location before it can be amplified. If the signal is not reaching the aerial, no amount of amplification will help. On the other hand, if there is a trace of signal and a large amount of amplification is used, then the signal-to-noise ratio of the overall system is the determining factor as to whether the wanted signal is usable or not. Possibly the best approach to your problem would be to obtain a high gain aerial for the channels of interest and, using it in conjunction with the TV booster amplifier, find the best location and height for the aerial. There is little more that could be done.

DIGITAL CLOCKS: I have noticed that two digital clocks were published using the National Semiconductor MM5314 clock chip, but using different displays. One used the Sperry SP151 neon readout (September 1973) and the other used four NEC LD8051 fluorescent readouts (April 1975). The second clock used fewer components and was much cheaper.

I have been wondering if the digital clock published in December 1974 could use four fluorescent readouts instead of the neon readout specified. This would mean that the driver transistors could be eliminated. The display printed circuit board could be replaced with a DIP board, and driver transistors 1-23 replaced by wire links.

Separate wires would be used between the transformer and the readout filaments. This would eliminate dangerous voltages from the circuit, and cut the cost of the clock. However, there are some questions which I would like to ask.

Will the automatic brilliance control work with fluorescent readouts? What alterations will have to be made to TR7 & 9, and D10 & 11? Will the driver circuits for the relays remain the same? Will a voltage reducing resistor be necessary for the resistor driving circuitry and the chip? Will four diodes be necessary across segments a and e? (D.S., Hendra Qld.).

● Although it would be possible to modify the digital alarm clock and use fluorescent readouts instead of the Sperry display, we would not recommend this, as some of the features of the clock would be difficult to provide with this type of readout. Among these would be the AM/FM indication, and the colon separating the hours from the minutes.

If such a modification was made, then the automatic brilliance control would still operate. Unless some provision was made for a colon, then the associated components could be removed. The driver circuits for the relays would remain the same. We are unable to answer your last two queries, as we cannot follow your intention.

REPLACEMENT TRANSISTORS: I am writing in answer to the letter by I.K. in your May issue regarding a replacement for, or information on a type 2SB474 transistor.

An American D.A.T.A. book I have lists the following specifications: 2SB474, GER PNP, derating 200mW/°C, Pc + 12W, Icm + 2A, Vcbo + 35V, Vceo + 35V, Vebo + 6V, Icbo + 200uA, h_{fe} = 50-275 at 1.5V Vce and 200mA Ic. The case is a standard T03.

An ASZ16 could be a possible replacement, although its h_{fe} may be a bit low. I hope that this info. will be of use to I.K. (D.P., Sale, Vic.).

● As you can see, D.P., we have passed on your information by reprinting it here. We also hope that it will be of help.

More recently we have been advised by Sanyo-Guthrie Pty Ltd, 40 Punari St, Currajong, Queensland 4810, that they can supply the 2SB474 transistor. Price is $3.60 plus 27½% tax.

Our thanks to the above company and other readers who have submitted advice for this reader.

CONTINUOUS LOOP CARTRIDGES: I have noticed in your magazine articles dealing with the development of tape recording. However, little has been published about the continuous loop cartridge as used in broadcasting.

In superstructure, the broadcasting cartridge resembles the 8-track cartridge, but has a different track configuration. There are two tracks only, and these are broadcast in parallel. One track carries the advertisement, promotion jingle or station announcement; the other track carries the necessary switching tones.

In addition, broadcasting cartridges are played at a speed of 7½ ips (19 cms) whereas the normal 8-track cartridge is played at 3¾ ips (9.5 cms). Also, the maximum playing time is only 5 minutes compared witF an average of 80 minutes for 8-track cartridges.

I hope that this information will fill certain gaps in many reader's minds. (R.S., Muswellbrook, NSW.)

● Thank you for your interest, R.S., and as you can see, we have reprinted your information for the aid of any interested readers.

SOLID STATE CRO: I am a regular reader of "Electronics Australia" and compliment you on your articles and projects. Could you please publish details of a solid state CRO. The only circuits I can find are

in English magazines, and many of the components are impossible to obtain in Australia. (J.V., Mackay, Qld.)

Thanks for the compliments J.V. Unfortunately, we have no plans at this stage for a solid state CRO. Current market indications are that it would be virtually impossible to design a unit that could compete cost-wise with an equivalent commercial model. We do, however, have the situation constantly under review.

SPURIOUS S/W SIGNALS: I think I may have an explanation for the results obtained by N.T. from Victoria. (June 1975 issue.)

In 1958 I constructed the "Transporta Six" described in August 1958. This set does not have an RF stage but was such a good performer that I decided to try it as a car radio. I mounted it under the dash and connected an 8ft whip aerial via coax to the hot end of the base winding.

Daytime performance was good but at night there were a lot of "birdies" and I actually received stations on about 3.5MHz. Since the broadcast oscillator range is approximately 1MHz to 2.1MHz, the second harmonics would range from 2MHz to 4.2MHz. If these harmonics were strong enough and there were signals in the aerial ranging from 1.45MHz to 3.75MHz would it not be possible for these to produce 455KHz IF signals? (D.A., Findon, SA.)

• Thank you for the suggestion D.A., and we agree that the mathematics would seem to be correct. In fact, we feel that your explanation is almost certainly the answer, based on our own experience whenever there is insufficient preselection ahead of the mixer. aIn your case you probably aggravated the condition by the method of aerial connection, which would have been rather too tight. A "primary" winding added to the ferrite rod would perhaps have been a better approach.

SPEAKER PHASING: I have had in service for some time now the Playmaster 136 with which I am particularly pleased. Following my success with the 136 I tackled a pair of speakers. I chose the design issued by Plessey for the C80X twin cone 20 watt speakers. Recently I decided to add a pair of Phillips 1inch Dome type ADO160/T8 tweeters. When designing my crossover network I noticed that most "two way" speaker systems have the polarity of the tweeter reverse to that of the woofer. I am confused as to the reasons behind these connections. (D.P.W., Roseville, N.S.W.)

• The tweeter is connected to the crossover network with reverse polarity because of the phase reversal introduced by the crossover network. This ensures that the sounds from both the tweeter and the woofer are substantially in phase.

PLAYMASTER 127/128: Some time back I built your Playmaster 127 and 128 stereo amplifier and I am delighted to say that I am extremely pleased with the results. I have had a slight problem with one of the power amplifiers. I have been unable to obtain half the supply voltage at the junction of the two 0.5 ohm resistors. With the 1M pot fully adjusted I can only get 25 volts at this point.

Also some time back I built a stereo version of the Four Channel Audio Mixer described in February 1966 (File 1/MX/6) and I now have a question about the optional metering circuit.

Using a 500uA meter, what value should the 3.3k resistor be to give me a full scale sensitivity of 200mV? (C.V., Campbelltown, NSW.)

• A possible cause of the failure to obtain the correct voltage at the output of the amplifier is that the 10uF filter capacitor connected to the base of T7 is leaky. Try disconnecting the capacitor temporarily to see if the correct voltage can be obtained without it. If so, replace the capacitor.

To obtain FSD sensitivity of 200mV in the mixer optional metering circuitry, reduce the 3.3k resistor to 1.8k. This may have to be "trimmed" with high value shunt resistors to get an accurate result.

NOTES & ERRATA

PLAYMASTER 146 AM-FM TUNER (July, August, September, 1975, File Nos. 2/TU/42,43,44): In July, 1975, PCB drawing p41: The unidentified point from pin 15 of TDA1200 is AGC for front end. In block line, H should refer to AFC instead of AGC. September 1975 PCB drawing p50, 120k resistor should be on aerial AM gang section, instead of oscillator. Add to parts list. 1 power transformer, 240V to 12.6V at 150mA. (PF2851, 6474, or similar.) In the circuit diagram in August, p35, the connection diagram for the BF199 has base and collector reversed. The discrepancy between the circuit and wiring diagrams, relating to the 330pF injection capacitor may be ignored as either connection is in order.

SILICON TRANSISTOR TESTER (October 1975, File No. 7/VT/12): Two contacts on the negative side of S2 are shown strapped. In fact, this is a drawing error and the configuration should be similar to that on the positive side.

WHAT'S NEW IN SOLID STATE (November 1975): Local agents for the Elremco ICs, including the LR171E timer are Cema Distributors Pty Ltd, 21 Chandos St, Crows Nest 2065, not the firm quoted.

SERVICEMAN from p.69

vicemen rarely stay around that long to check on the behaviour of a set!

By the time it gets round to the second call-back, patience is usually starting to get a little strained—on both sides! And a third call back? Phew!

It was just good fortune in this case that I was able to see the symptoms personally and react to them in a logical, if protracted manner—without running up a lot of workshop or travelling time.

As it is, my stocks with the owner couldn't be higher but I'm still intrigued by the thought of how matters might have stood if my encounter with the receiver had been on a more ordinary plane.

You can't lose 'em all!

SIMPLE TELEPHONE EXCHANGE from p.75

completes the interrupted ring tone circuit via HL1 to the tone bank. Thus, interrupted ring tone means the level is between acceptable limits.

When the level rises to the upper probe its transistor is forward biased, relay HL operates, and contact HL1 switches to dial tone. Thus, dial tone means the level is too high.

Note that the water must be earthed in order to forward bias the transistors. This will be naturally so in the case of a dam and usually so in the case of a tank. If not it can be made so.

There have been numerous enquiries about providing two or more simultaneous calls. Unfortunately, there is no way this can be done by "sticking in a few more relays". A typical 22 line two link exchange would require four uniselectors and nearly 60 relays or, putting it another way, a two link exchange would, as a general rule, use four times the equipment of a one link system.

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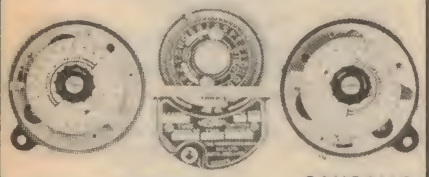

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For controlling incandescent lamps from full to out at up to 1200 watts. Consists of triac, diac, capacitors, resistors, potentiometer, knob, ferrite rod, enamel wire & circuit.

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Motor/Drive System: 4-pole synchronous motor-belt drive. Speeds: 33⅓ and 45 rpm. Wow and Flutter: Less than 0.07% WRMS. Cartridge: Moving magnet. Frequency Response: 20-20,000 Hz. Fitted with anti-skating device. Manual operation.
$139.00*

NEW FOR '76

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NEW FOR '76

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*Recommended Retail Price
**Averaged manufacturers' specifications subject to change without notice.

A turntable is the principal programme source of a hi-fi system and is made up of many intricate parts, one of which is the tone arm and when fitted with a stylus traces the modulation grooves of your record and sends the ensuing signal to your amplifier. The turntables above are examples of good turntables. They aren't cheap, but nor is any good hi-fi component. Their specifications and features are their credentials. If you understand them, you'll know just how good they are. If you're a bit lost with the specifications, we have just the thing: "The New, Improved, Updated, More Detailed Hi-Fi Explained in Simple Language by Kenwood Booklet". It will make these specifications much clearer. Because when you know more about good hi-fi, you'll be better able to appreciate Kenwood hi-fi.

KENWOOD

WHAT GOOD HI-FI IS ALL ABOUT

We want you to know what good hi-fi is all about, so we are giving you our booklet absolutely free. It is a complete dictionary of hi-fi terms and explanations, available at your nearest hi-fi specialist, displaying the Kenwood sign.

JM 253

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For those who are after a total package in Hi-Fi, JVC presents "CREATION.310" Components specially matched so that each and every unit complements one another.

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The JLA1 belt drive turntable with auto return/auto shut off completes this very impressive package.

"CREATION 310" is a precision marriage of JVC components designed to impress your ears. Your eyes too will be impressed, for an optional table is available to house this system in a neat package.

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